Operating Instructions

VMF 2000

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Oct. 30th, 2008 These operating instructions apply for the software version 3.46.

1 Introduction

The measuring and control instrument VMF 2000, in combination with either one or two transducers, is used for acquiring thickness.

Measuring values or calculated results are output as exact numerical values on a seven-digit display and, in addition, as scale values on a dial-type indicator. This results in optimum read-off possibilities for all sorts of application:

For reading off measuring values, the numerical display is favorable,
for recognizing trends and reversing points, the analogue indicator is ideally suited.

This instrument features a great variety of measuring and evaluation possibilities. They reach from the simple indication of the directly acquired value, over sum and differential measurements with two transducers to the statistical evaluation of complete measurement series including mean value, standard deviation and range. In addition to the standard measuring range with a resolution of 0.1 µm, there is a fine measuring range with the high resolution of 0.01 µm.

Tolerances can be set and precisely monitored. The built-in pilot lamps which arrange the test pieces into the groups "Accept", "Rework", and "Reject" are used for the visual indication. The corresponding information on the test piece can also be transferred via the interfaces to external instruments.

The VMF 2000 features a variety of inputs and outputs which can be connected directly to a stored program control (PLC). Printers and host computers can be connected via two serial interfaces. Host computers can not only receive data sent by the VMF 2000, they can also control many of its functions. Control units, recorders, indicating instruments, etc. can be connected to three analogue outputs the parameters of which can be set independently from each other, thus enabling the instrument's complete integration into the production process.

This instrument also features numerous auxiliary functions, e.g. symmetry and adjusting the sensitivity of the transducer. The function "blanking out disturbances" with its adjustable parameters can be used for largely suppressing interferences on the measuring signal.

Naturally, not all instrument functions will be used to the same extent. Therefore, you can tailor the user interface to suit your special demands. The possible evaluations can be restricted to the indication of the actually necessary results. If for some special application a not directly accessible function is required, the function in question may be assigned to a function key. The function can now be called up at any time by simply pressing this key.

In spite of its many functions, the VMF 2000 is easy to operate, such that even non-specialists and temporary users can work with this instrument without any difficulties.

2 Operating elements

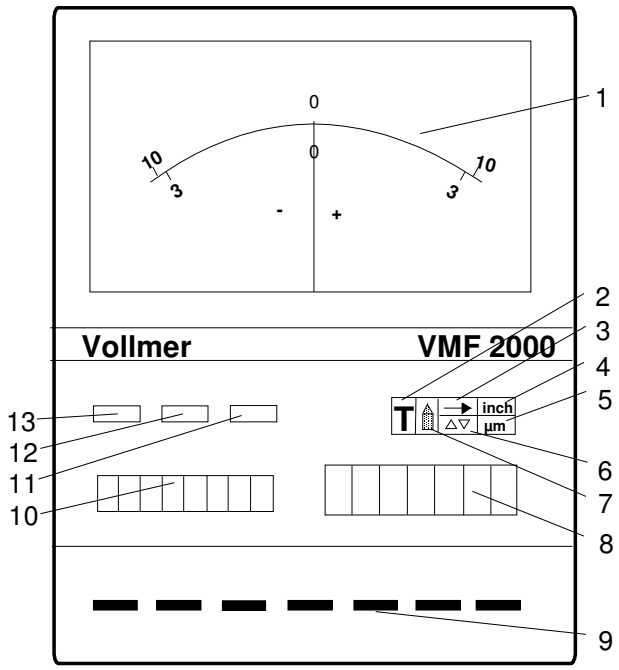


Fig. 1
Front panel

1 Analogue Instrument
2 Start/Stop indicator
3 Overflow indicator
4 Inch indicator
5 µm indicator
6 Setting/Configuration indicator
7 Change-over indicator
8 Numerical display (6 digits + sign)
9 Keys
10 Text indication (8 digits)
11 Pilot lamp, yellow
12 Pilot lamp, green
13 Pilot lamp, red

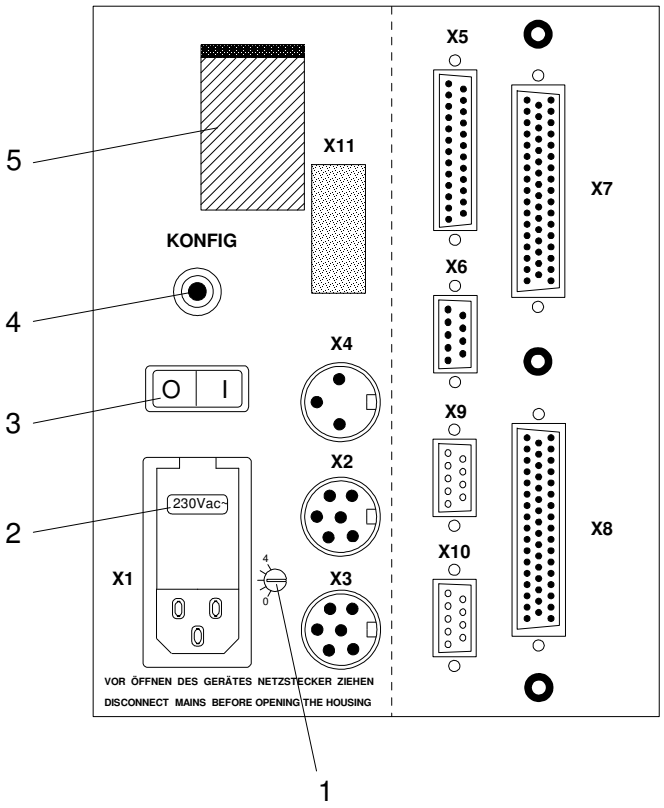


Fig. 2
Rear panel

X1: Mains connection
X2: Socket for connecting transducer A
X3: Socket for connecting transducer B
X4: Analogue output
X5: Analogue/digital outputs
X6: Interface measuring/reference instrument
X7: BCD inputs and outputs
X8: Control signals
X9: Host computer interface
X10: Printer interface
X11: not yet assigned

1 Selector switch for cable compensation
2 Voltage selector
3 On/Off switch
4 "Konfig." key for changing the instrument configuration
5 Type plate

To each key, three function levels are assigned:

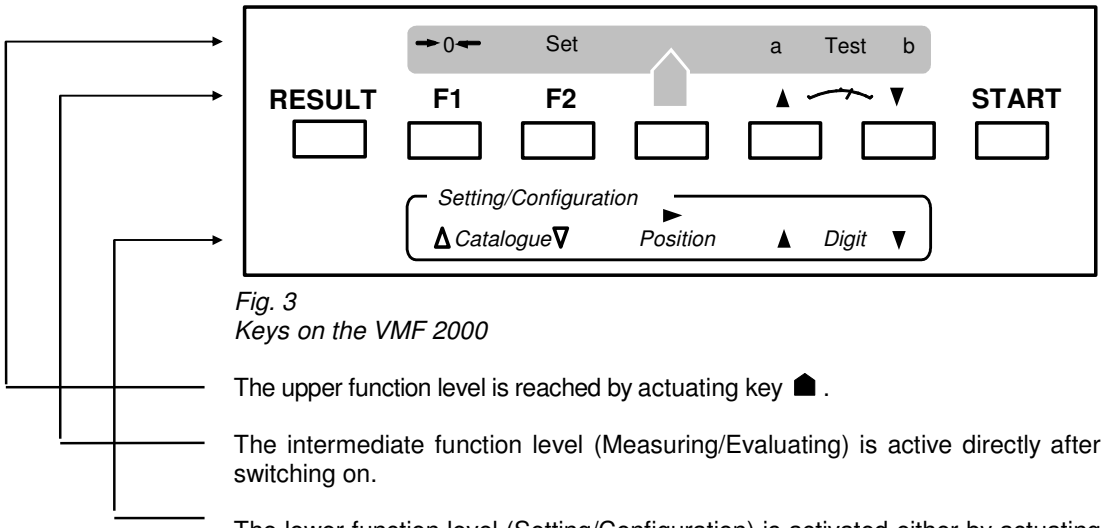


Fig. 3
Keys on the VMF 2000

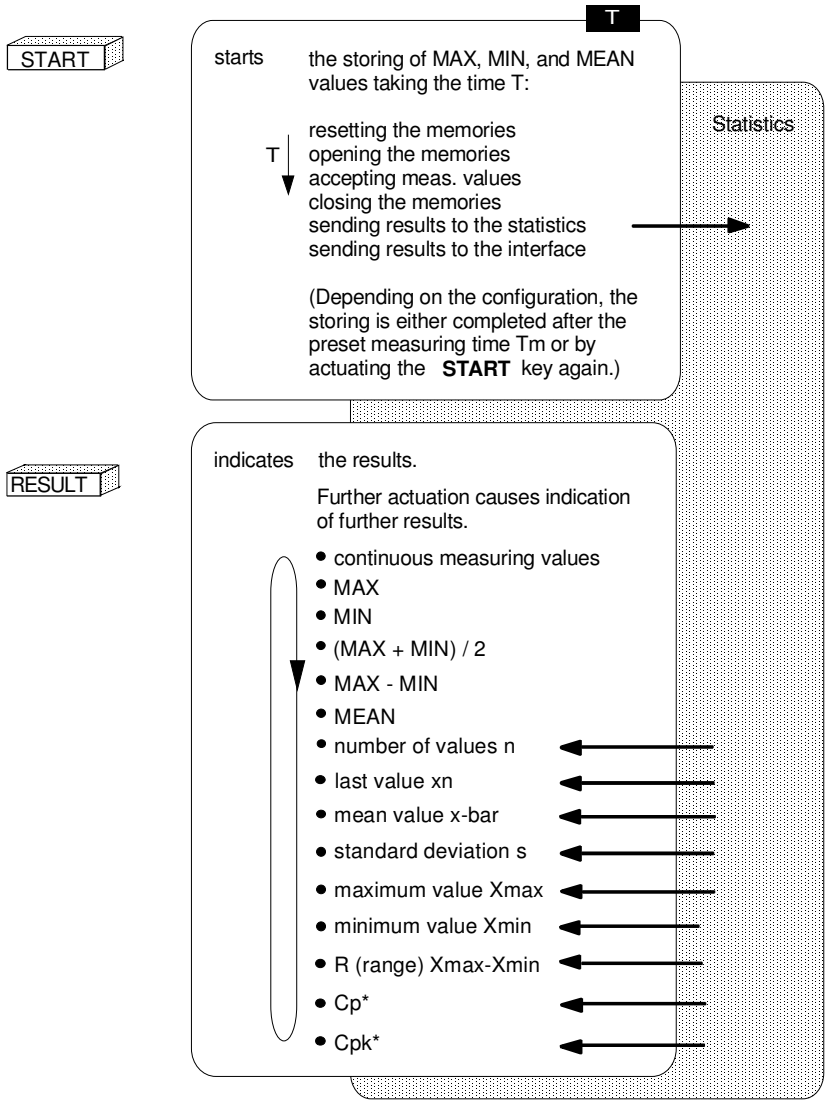
The upper function level is reached by actuating key ⌂ .

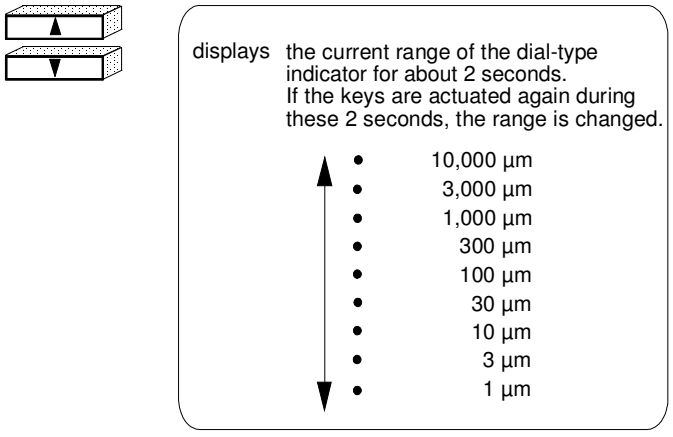
The intermediate function level (Measuring/Evaluating) is active directly after switching on.

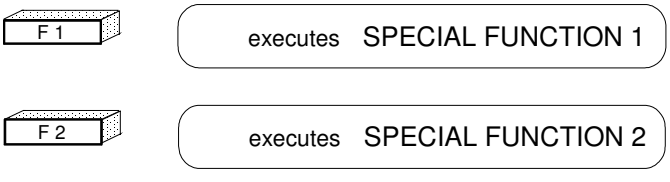
The lower function level (Setting/Configuration) is activated either by actuating the keys ⌂ and **SETTING** or by actuating the **Konfig.** key (cf. fig. 2 point 4) on the rear side of the instrument. The setting/configuration indicator (cf. fig. 1 point 6) starts to light up.

As a rule, the keys of the VMF 2000 are actuated by only slightly touching them.

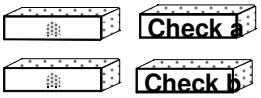
The functions of the individual keys will be presented graphically on the following pages. By repeatedly pressing certain keys, the parameter catalogue will be scrolled. The lower function level can be abandoned at any time with **RESULT**.


START
T
starts
the storing of MAX, MIN, and MEAN values taking the time T:
T
resetting the memories
opening the memories
accepting meas. values
closing the memories
sending results to the statistics
sending results to the interface
(Depending on the configuration, the storing is either completed after the preset measuring time Tm or by actuating the START key again.)
Statistics
RESULT
indicates
the results.
Further actuation causes indication of further results.
• continuous measuring values
• MAX
• MIN
• (MAX + MIN) / 2
• MAX - MIN
• MEAN
• number of values n
• last value xn
• mean value x-bar
• standard deviation s
• maximum value Xmax
• minimum value Xmin
• R (range) Xmax-Xmin
• Cp*
• Cpk*

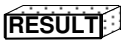

displays
the current range of the dial-type indicator for about 2 seconds.
If the keys are actuated again during these 2 seconds, the range is changed.
• 10,000 µm
• 3,000 µm
• 1,000 µm
• 300 µm
• 100 µm
• 30 µm
• 10 µm
• 3 µm
• 1 µm


F 1
executes SPECIAL FUNCTION 1
F 2
executes SPECIAL FUNCTION 2

sets **the current measuring value to the value (master value) or**

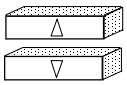


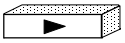
indicates **the individual probe value directly,**
- without master value 0
- without "Factor A
- without
- without nominal

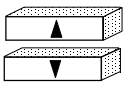
return with 

or

starts setting of measuring conditions.


Scrolling the catalogue


Selecting desired position


Changing individual digits

- "Master actual value" -199,999.9 ... + 199,999.9 µm
- "Nominal value" 0 ... +1,999,999 µm
- Upper tolerance -199,999.9 ... +199,999.9 µm
- Lower tolerance -199,999.9 ... +199,999.9 µm

return with

or

3 Putting into operation

Before putting into operation for the first time, by all means check whether or not the voltage was adjusted correctly. The set voltage has to agree with the local mains voltage!

Adjusting the mains voltage:

1. Disconnect the mains plug.

2. Open the cover of the voltage selector (see figure 2) by means of a screw driver and swing it down. For reasons of safety, the cover can only be opened if the mains plug is disconnected.

3. Pull out the voltage selector roll and insert it in such a way that the correct voltage can be seen in the window after closing the cover.

An incorrectly set mains voltage may cause instrument defects which might endanger life and health of the operator!

Exchanging fuses:

After the cover of the voltage selector has been opened, the two fuses are accessible. Defective fuses may only be replaced by fine wire fuses (5 x 20 mm) of the below type, irrespective of the mains voltage:

630 mA, time-lag

Make sure when connecting the probes to the VMF 2000 that the plugs are always screwed firmly to the corresponding socket on the rear side of the instrument.

The On/Off switch serves for switching on and off the instrument.

The text indication successively displays:

the instrument designation	"VMF 2000",
the version number, e.g.	"Rev. 3.46"
and	"Check".

While these texts are being indicated, a self-test is performed. After approx. 15 s, the instrument is ready for operation. The text indication now shows the master value stored last. The numerical display and the dial-type indicator display the corresponding measuring result.

4 Adjusting the measuring conditions

The measuring conditions can be adjusted after having pressed the keys ☗ and **SETTING**.

In accordance with the measuring problem, the operator may adjust:

- the master value "Master"
- the nominal value "Nom. val."
- the upper tolerance "up. Tol."
- the lower tolerance "low. Tol."

The standard routine for adjusting the measuring conditions is as follows:

1 Activating the measuring condition adjustment with ☗ and **SETTING.** Indicator (6) lights up.

2. Selecting the parameter with △ and ▽.

3. Selecting the digit with ▶.

4. Setting the numerical value with ▲ or ▼.

5. Concluding the measuring condition adjustment with **RESULT** or selecting further parameters with △ or ▽.

Steps 3 and 4 have to be repeated for each digit of the numerical value.

The adjustment of measuring conditions is concluded by pressing the key **RESULT**.

4.1 Master value

During a master measurement, the instrument can be set to a defined master value (master deviation) by means of the function ⊢O⊣. Via the function SETTING, this master value can be selected and entered. On activating the function ⊢O⊣, this value will be displayed. The master value to be entered is the deviation of the master actual value from the nominal value.

Master value to be entered = Master actual value – Nominal value

Proceed as follows:
Use the function SETTING to select the parameter "Master" and enter the deviation of the master actual value from the nominal value. Place the master into the measuring unit and actuate the keys ☗ and ⊢O⊣.

The master value will be displayed.

All subsequent workpiece measurements are now referred to this master value.

Example:
Given are a nominal value of 122.050 mm and a master actual value of 121.010 mm. The master value to be entered is calculated as follows:

121.010 mm - 122.050 mm = -1.040 mm

Thus -1,040 µm is the master value to be entered.

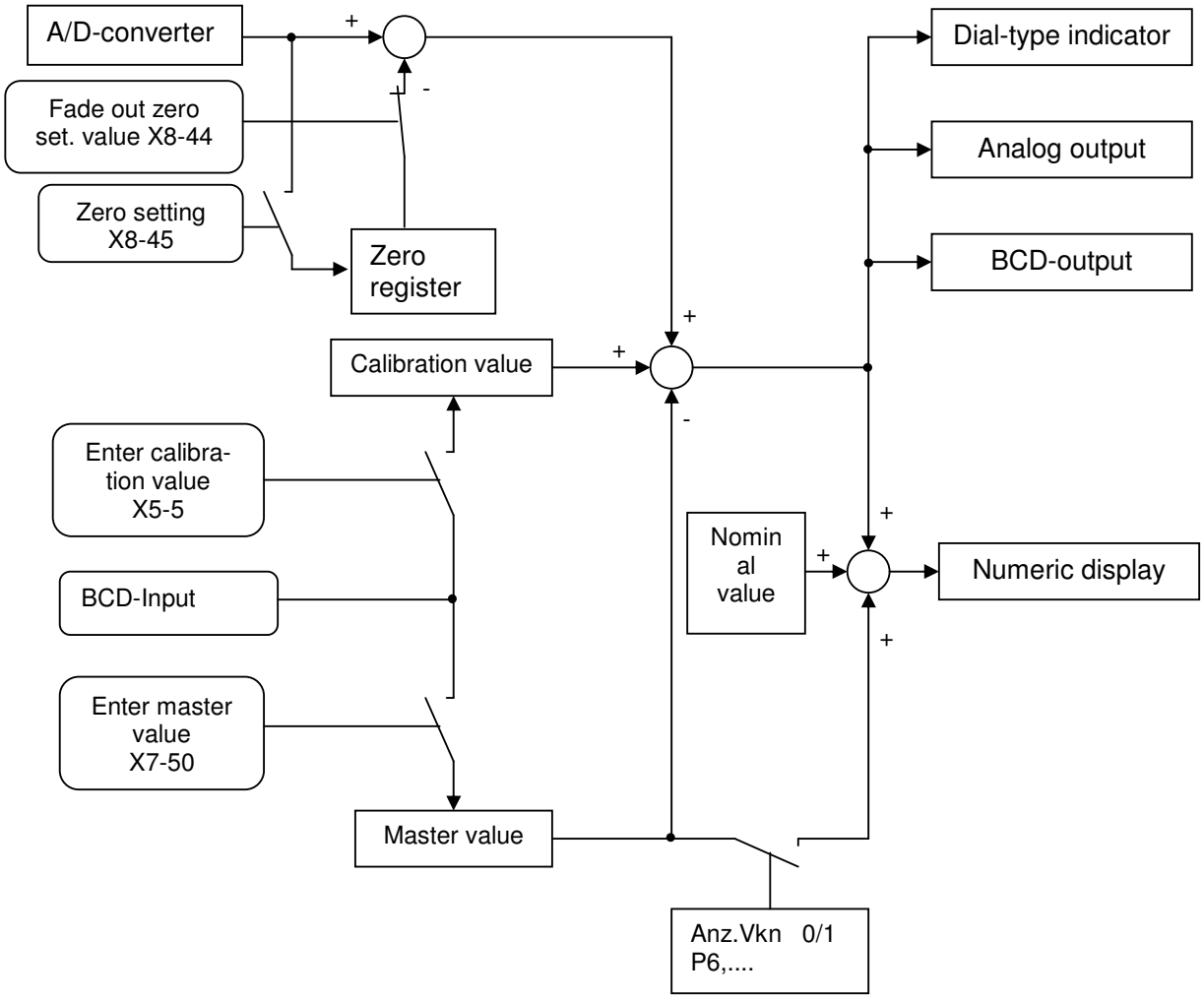
The master value may also be entered via the BCD inputs or the RS232 interface.

4.1.1 Calibration value

If the workpieces zero is outside the measuring range the difference has to be bridged by a gage block.

1. Place gage block (=calibration value) between probes and adjust probes mechanically to a reading close to zero.
2. Enter calibration value (= size of the gage block)) via BCD inputs with signal „Enter calibration value“ (X5-5).
3. Activate input “zero setting“. The dial type indicator shows 0 if the nominal value equals the calibration value. Depending on the parameterization the numeric display shows the calibration value or zero.
4. Enter the nominal value via the BCD inputs by activating „Enter master value “. Die dial-type indicator shows the deviation of this nominal value while the numeric display shows the actual value or the deviation from the nominal value.
5. The numeric range of the calibration value and the nominal value is 0000.0...9999,9 µm. Via the BCD inputs the calibration value is always assumed as a positive value while the nominal value is always assumed to be negative.

Calculation of a measuring value (Schematics)



4.2 Nominal value

In case actual values instead of relative ones are to be indicated, nominal values in a range between 0 and 2 m, i.e. 0 and 1,999,999 µm, can be entered. Here, only positive values are allowed.
The nominal value will be added to the measuring result. The sum will only be indicated on the numerical display, but not on the dial-type indicator, which continues to indicate the deviation from the nominal value. Please note that the tolerance indication and the tolerance limits are also referred only to the deviation from the nominal value.

"Nom. val." (nominal value) is to be selected and entered (0 ... 1,999,999 µm) via the function **SETTING**.

Example:
Given are a nominal value of 122.050 mm and an indicated measuring result of 85 µm. Use the function **SETTING** to select parameter "Nom. val." and enter the nominal value in micrometers, i.e. 122,050 µm.
The numerical display now indicates the real actual value of the workpiece, namely 122,135.0 µm, while the dial-type indicator continues to display the deviation from the nominal value, i.e. 85 µm.

NOTE The range of indication of the numerical display is limited to ±1,999,999 µm. In case this range is exceeded, "+1" or "-1", respectively, will be indicated. This is the reason why for large absolute values the resolution must be reduced to 1 µm.

4.3 Tolerance monitoring

Tolerance monitoring means that all measuring values are compared with the tolerance limits. Differently colored pilot lamps indicate whether the measuring value

- exceeds the upper tolerance limit,
- lies within the tolerance zone,
- exceeds the lower tolerance limit.

For tolerance monitoring, one of the measuring results below may be chosen:

- **COMBINE** current measuring value acc. to probe combination
- **MAX** maximum value during a measuring series
- **MIN** minimum value during a measuring series
- **(MX+M)/2** arithmetic mean value of MAX and MIN
- **MAX - MIN** difference between MAX and MIN
- **MEAN** mean value of all measuring values gathered in a measuring series

The tolerance limits, which can be adjusted in a range between
-199,999.9 µm and +199,999.9 µm,

are selected via the parameters
"up. Tol." (upper tolerance limit) or
"low. Tol." (lower tolerance limit).

The smaller value is always assigned to the lower tolerance limit.
The larger value is always assigned to the upper tolerance limit.

If the measuring result lies within the preset tolerances, the green pilot lamp (see fig. 1 point 12) starts to light up, thus classifying the workpiece into the "Accept" group.

In case the upper or lower tolerance limits are exceeded, the yellow (see fig. 1 point 11) or red (see fig. 1 point 13) pilot lamps light up. These lamps indicate

"Reject" components (red lamp), for which too much material was taken off, and
"Rework" components (yellow lamp), for which not enough material was removed.

Which of the two lamps in question will light up depends on the type of measurement carried out, i.e. an internal or external measurement. The type of measurement to be carried out must thus be stated in the configuration settings beforehand.

Hysteresis of tolerance monitoring

Under adverse measuring conditions (e.g. vibrations), pilot lamp flickering in case of close-to-tolerance measuring results is possible. In order to avoid this, a switching hysteresis can be established. Here, the preset tolerance limit is extended symmetrically by a certain, selectable value. If the measuring results now lie within the hysteresis range of the tolerance limits, the state of the pilot lamps does not change.

Basic principle of hysteresis:
With a switching hysteresis selected, the current and the preceding measuring result determine whether or not a result lies within the tolerance limits. Thus, the following is valid for measuring results in the range of the hysteresis:

Any result within the hysteresis range is considered to be within limits, if it and the directly preceding result are within limits. In case the preceding result was off limits, the current result in the hysteresis range is considered off-limits as well.

The switching hysteresis can be adjusted in a range between 0 and 99.99 µm after calling up parameter "Hystere." in the configuration level.

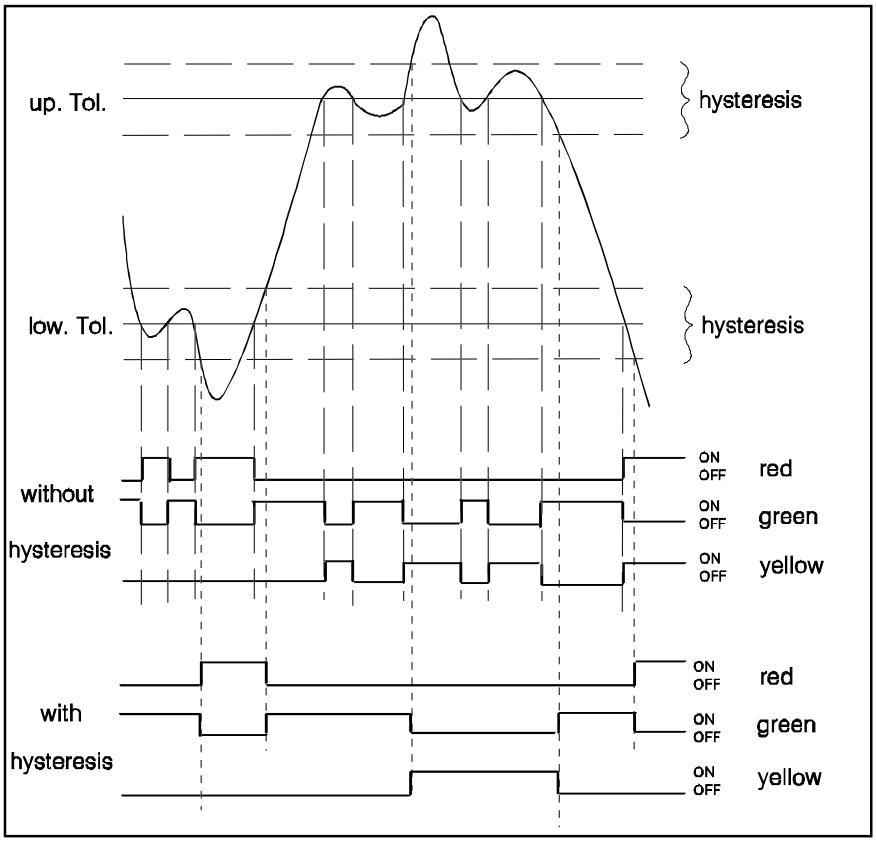


Fig. 5
Influence of the switching hysteresis on tolerance monitoring. The present example shows the course of the measuring values during an external measurement together with the tolerance monitoring results. (For reasons of improved illustration, the hysteresis is represented superproportionally large.)

4.4 Classification

The classification always refers to the measuring result which was selected for tolerance monitoring (with "Sel.tol"). Whenever the control signal "accept value into statistics" is released or the measuring time Tm ended, the results are sorted into groups according to their numerical values.

Classification, i.e. adjusting the class limits, is carried out automatically. The range between the upper and lower tolerance limit is divided into classes of equal width.

The number of classes has to be set in the instrument configuration level.

After having actuated **Konfig.** on the rear of the instrument, use the key △ or ▽ to set the indication to "Classes" and actuate the keys ► and ▲ or ▼ to enter the desired number of classes (1 ... 30).
By entering "0", classification will be switched off.

The class limits are adjusted after leaving this menu point.

Example for automatic classification:
In case there are 5 classes between - 2,000 µm (lower tolerance limit) and +2,000 µm (upper tolerance limit), a class width of 800 µm and the following class limits will result for automatic classification:

Cl.l. 0:-2,000.00		
Cl.l. 1:-1,200.00	(from	-2,000 µm to<-1,200 µm)
Cl.l. 2:-400.00	(from	-1,200µm to<-400 µm)
Cl.l. 3:400.00	(from	- 400 µm to<+400 µm)
Cl.l. 4:1,200.00	(from	+400 µm to<+1,200 µm)
Cl.l. 5:2,000.00	(from	+1,200 µm to<+2,000 µm)

Please note that due to the chosen hysteresis, the reversing points between the individual classes are extended.
A measuring result which is in the range of the hysteresis is automatically assigned to the lower class, provided that the directly preceding result was also assigned to the lower class. If it was grouped into the higher class, the current result will be assigned to the higher class as well.

Printing out the classification results:

When printing out individual values, the class is printed out in the column following the classified measuring result.

When calling up the function "Prnt stat" (= print statistics), a table is printed out which contains the class limits, the number of individual values in this class and a histogram with the graphical representation of the distribution function.

This histogram is deleted on deleting the statistics completely ("Clr stat").

Whenever changing the tolerance limits, the function "Clear statistics" has to be called up since otherwise totally wrong classification results will be printed out.

4.5 Correction factors

The measuring values supplied by the transducers A and B are multiplied individually by an adjustable factor. On doing so,

- sensitivity errors of the transducers are compensated for,
- the lever factors of the reversing levers inside the measuring unit are taken into consideration,
- the multipliers for the measuring result are taken into account.

Note: For compensating for sensitivity errors of the transducers, the VMF 2000 offers two auxiliary functions (see "Adjusting the sensitivity" and "Symmetry"

Adjusting the correction factors:

1. Actuate the key **Konfig.** on the rear of the instrument.
2. Select "Factor A" or "Factor B" with △ or ▽ .
3. Set the numerical value with ►, ▲ and ▼ .
   (Range 0 ... 99.9999; only positive values are allowed. Negative values have to be entered via the probe combination adjustment.)
4. Select further parameters with △ or ▽ or conclude with **RESULT**.

For both factors, the default setting is 1.0000.

If several correction factors are at hand for one transducer, these are multiplied with each other and then entered as one common "Factor A" or "Factor B".

Examples for adjusting the correction factor

Example 1
Transducer A features a sensitivity error of + 0.5 %.
The correction factor ("Factor A") then amounts to (1 : 1.005 =) 0.9950.

Example 2
A reversing lever mounted in front of transducer B causes a demultiplication of 0.75. The value to be entered for "Factor B" is (1 : 0.75 =) 1.3333.

Example 3
The measuring result of transducer A divided by two is to be indicated. The value of "Factor A" then is (1 : 2 =) 0.5.

Example 4
In a measuring set-up, the following transducer factors have to be considered in common:

- Correction factor due to the sensitivity error of the transducer = 0.9950
- Correction factor due to the error caused by the reversing lever = 1.3333
- Correction factor due to the conversion of the measuring result = 0.5

The common correction "Factor A" then is (0.9950 * 1.3333 * 0.5 =) 0.6633.

4.6 Measuring range

The instrument features two measuring ranges, namely

±2,000 µm (resolution 0.1 µm) and
± 200 µm (resolution 0.01 µm)

After actuating the key **Konfig.** on the rear side of the instrument, select the measuring range by either calling up the indication

"MR. ± 2000"

by means of the keys △ or ▽ or changing it to

"MR. ± 200"

by means of the keys ▲ or ▼.

In case the measuring range is clearly surpassed, the overflow indicator (see fig. 1 point 3) starts to light up. No more measurements are possible thereafter.*

The measuring range is not dependent on the indication range of the numerical display. The resolution of all indicated and output values, however, is determined by the selected measuring range.

* Moreover, the overflow indicator takes into account the selected correction factor, i.e. if the correction factor is <1, the overflow indicator already starts to light up within the measuring range and vice versa.

4.7 Start, stop, measuring time, pause, delay

The measuring time is the time during which the memories for maximum, minimum and mean value are open. The open state of the memories is indicated by "T" being displayed. Before new measurements over the measuring time Tm are started, the memories are cleared to enable the storing of new values. Whenever the measuring time Tm is ended, the result selected via the instrument configuration setting "Sel.stat" is accepted into the statistics memory and the results selected via "Sel.Prnt" are printed out.

The measuring time can be started and ended in three ways:

Manual

1. Manual control of the measuring time via Start/Stop
Press the key **Konfig.** on the rear of the instrument and select the parameter
"**STRT man**".

The measuring time is started by simply pressing the **START** key and ended whenever wanted by pressing the **START** key again.

Preset

2. Measurement over a certain preset period of time
Press the key **Konfig.** on the rear of the instrument and select the parameter

"STRT Tm".

The measuring time starts after actuating the **START** key and ends automatically after the preset time Tm.
For adjusting the measuring time (in seconds), set the parameter

"Tm [s]"

in the instrument configuration to a value in the range between 0.01 s and 999.99 s by means of the keys ►, ▲ , or ▼.

Intervals

3. Given measuring time, cyclical repetition of measuring run (measurements in intervals)
Press the key **Konfig.** on the rear of the instrument and select the parameter

"STRT Tp".

Pause

The measurement starts after having actuated the key **START** and ends after the preset time Tm. After a pause time Tp, the measuring run starts again. The cyclical repetition of the measuring time Tm and the pause time Tp is ended on actuating the key **START** again.

The length of the pause **"Tp [s]"** is entered in the same way as the measuring time Tm (0.01 ... 999.99 s).

Delay

By entering a delay time Td, between 0 and 99.99 seconds, the start of the measurement will be delayed. Td is entered in the same way as Tm.

Interruption

The measurement can be interrupted on actuating the keys ☗ and **START** and continued by actuating these keys again (☗ , **START**).

Adjusting the parameters Tm and Td is also necessary for the measuring/reference function.

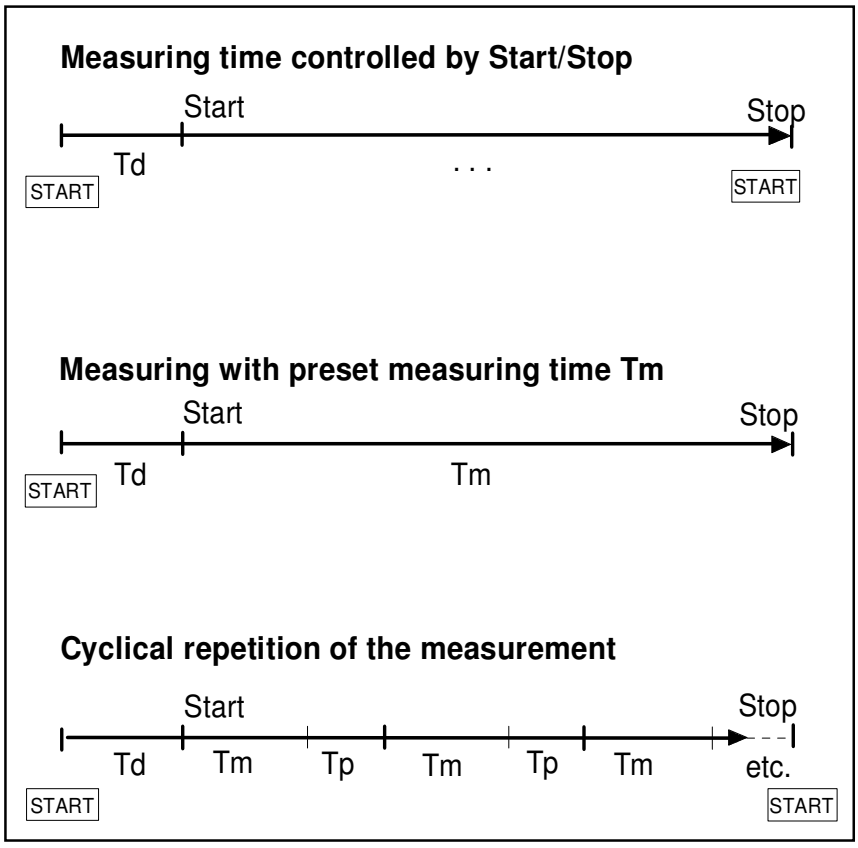


Fig. 6
Measurements with differing measuring time control
Tm = measuring time
Td = (initial) delay time
Tp = pause time

4.8 Storing the settings permanently

Changed measuring conditions and instrument settings are deleted on switching off the instrument. When switching on again, the instrument presents the settings that have been stored last.

However, all settings can be stored permanently by means of the function "Save". For this, select "Save" in the instrument configuration and press ►. The following safety inquiry must be answered by pressing ▼ or aborted by pressing any other key.
Each time the instrument configuration is stored, the version number of the software is also stored. When switching on the VMF 2000, the version number stored in the EPROM is compared to the stored version number. If the version numbers differ, e.g. after having exchanged the EPROM, the instrument indicates "Rev-Fehl". The VMF 2000 may no longer function correctly. Load the standard configuration "S.config" and store it by means of the function "Save".

There is one permanently stored standard setting for measuring conditions and instrument settings to which the instrument is adjusted on delivery. This standard setting can be recalled at any time although the user may have permanently stored further settings. The measuring conditions and the instrument configuration entered and stored permanently by the user, however, will only be overwritten (and deleted!) if the standard setting is stored again by means of the function "Save". Otherwise, the permanently stored user-specific settings continue to be valid after switching off and on again. Thus, intermediate work with standard settings does not automatically entail the deletion of customer-specific settings.

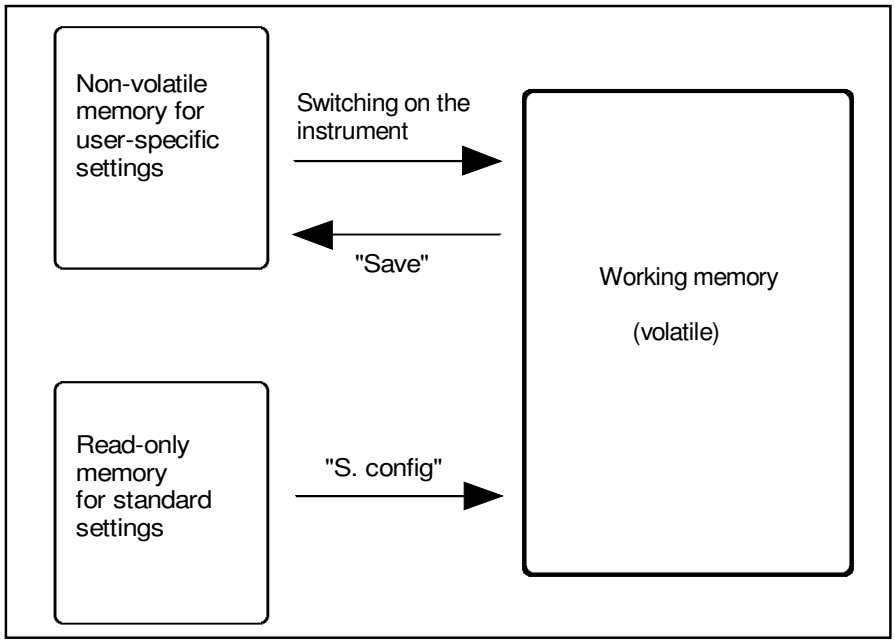


Fig. 7
Storing instrument settings in the volatile working memory, the non-volatile memory, and the standard-settings memory. The settings in the working memory are always the ones which are used.

5 Measurement and evaluation

After switching on, the instrument is in its basic condition. The transducer value is determined continuously and indicated according to the selected transducer combination. In case the instrument is not in its basic condition, this condition can be re-established by actuating either **RESULT** or **START**.

5.1 Checking the transducer signal indication

For checking purposes (e.g. during setting-up), the actuation of key **Check a** or **Check b** results in the indication of the current probe value,

- without transducer combination,
- without correction factor,
- without master value,
- without nominal value.

i.e. as an unprocessed raw value.

In this case, (accept master value) has no function!

Usually, these keys are only used during setting-up for checking correct transducer clamping or ensuring perfect transducer functioning. The zero position indicated here marks the electrical zero point of the transducer.

The transducer signal check is ended on pressing the key **RESULT**.

5.2 Indication ranges of the dial-type indicator

When monitoring measuring runs, the fast and reliable determination of trends and reversing points is decisive. The dial-type indicator and the possibility to choose among several indication ranges makes allowance for the above demand.

Usually, the dial-type indicator and the numerical display provide equal readings. Exceptions to this rule are formed by the setting "Sel. ins 2" as well as the output of statistical results and nominal values. The following indication ranges can be selected independently of the measuring range:

±	10,000	µm
±	3,000	µm
±	1,000	µm
±	300	µm
±	100	µm
±	30	µm
±	10	µm
±	3	µm
±	1	µm

The numerically displayed values are not influenced by the indication range setting of the dial-type indicator.

The resolution of the displayed value is determined by the adjusted measuring range (see measuring range).

In case the instrument is in its basic condition, the actuation of one of the keys ▲ or ▼ causes the valid indication range to be displayed for about two seconds.
If during these two seconds the keys are pressed again, the subsequently smaller or larger indication range is selected. Continue pressing these keys until the desired range is adjusted.

It is no longer possible to change the indication range via the keyboard if the configuration locking is activated (Lock on).

The indication range can be selected via the control inputs Rxin (X8/14...17, 48...50), even if the configuration locking of the keyboard is active.

5.3 Measuring results

By repeatedly pressing the key **RESULT**, the following measuring results can be indicated ("measuring result" here describes the result of a dynamic measurement, i.e. a number of individual measuring results):

- **COMBINE** current measuring result as per selected transducer combination
- **MAX** maximum result during measurement (maximum value)
- **MIN** minimum result during measurement (minimum value)
- **(MX+M)/2** arithmetic mean value of maximum and minimum result
- **(MAX-MIN)** difference between maximum and minimum result
- **MEAN** mean value of all individual measuring results assessed during the measuring time Tm

Provided that the statistical evaluation was activated by the function "Stat. on", the statistical results of a measuring series can be indicated as well:

- **n** number of measurements or results
- **xn** last measuring result
- **x (x/)** x-bar, mean value of all results of all measurements
- **s** standard deviation of these values from the mean value
- **Xmax** maximum individual measuring result
- **Xmin** minimum individual measuring result
- **R** range, difference between the largest and smallest result of all measurements (Xmax - Xmin)
- **cp*** theoretical process capability
- **cpk*** actual process capability

***Note:** For the calculation of "cp" and "cpk", the gaussian distribution is not determined.

The measuring results to be indicated have to be selected beforehand in the instrument configuration.

For all statistical evaluations it is necessary to beforehand set "Stat. on" in the instrument configuration and select a measuring result, e.g. (MAX - MIN).

5.4 Statistics

One of the results

Combine, **MAX**, **MIN**, **(MX + M)/2**, **MAX - MIN** or **MEAN**

can be evaluated statistically.

The statistics can be run for a maximum of 25,000 measurements. After the end of the measuring time Tm or the activation of input "Accept value into statistics", the result will be accepted into the statistics. The number of the already acquired results "n" will be indicated for about two seconds.

Select

Actuate the key **Konfig.** on the rear of the instrument and select the configuration parameter "Stat. on". Afterwards, choose "Sel.stat" and depress the ► key. Now use ∇ to single out the measuring result for which the statistics is to be run and set it to "1" by means of the keys ▲ and ▼.

Restrict

With parameter "n max" it is possible to restrict the number of measurements for which the statistics is to be run.
As soon as the preset number of measurements is reached, no more results will be accepted into the statistics. Moreover, it is no longer possible to start a measurement. Only after having deleted the statistics completely or at least the last result, may commence the next measurement.

Depress the key **Konfig.** on the rear of the instrument and call up the parameter "n max". Establish the number of measurements to be evaluated statistically (0 to 25,000) by means of the keys ►, ▲ and ▼. In case "0" is input, the number of measurements to be evaluated statistically will not be restricted, i.e. 25,000 measurements will be taken. After having assessed the 25,000th measuring result, the instrument does not prevent the acquisition of further results. The statistics, however, will not be carried on.

Print

Actuate the key **Konfig.** on the rear of the instrument and select the parameter "PrntStat". The statistical record printout can now be started with ►.

Delete

It is possible to delete the **last** result or the complete statistics.
The last result x_n is deleted as follows:

- Select "Clr xn" in the instrument configuration and press key ►.
- After answering the safety inquiry "n-1?↓" by actuating the ▼ key, the ultimate result will be deleted.

The complete statistics will be cleared as follows:

- Select "Clr stat" in the instrument configuration and press key ►.
- After answering the safety inquiry "n=0?↓" by actuating the ▼ key, the statistics will be deleted completely.

The clear functions are executed directly. After the deletion, the instrument is in its basic condition.

The above-mentioned functions can also be assigned to function key **F1** or **F2** for making them directly available (see section 6.8).

The statistical results can also be deleted and printed out by means of control input signals (see section 6.2).

5.5 Printouts

It is possible to print out measuring results, statistical values and histograms in the form of a measuring record. All Epson or Epson-compatible printers with serial interface can be used for this purpose.

The printer is connected to the RS 232 C interface (via the cable, order no. 6860215). For this, set the instrument configuration parameter "PrntPara" to "1". Also check the baud rate and the transmission format.

Then, start the measurement by pressing the key **START**.

The measuring results Combine, MEAN, MAX, MIN, (MX+M)/2, and MAX-MIN (depending on the presetting) will be printed out directly after the measurement.

- **START** starts the measuring run the results of which will be stored.
- The measuring run ends either after the preset time Tm or after actuating the **START** key again.
- The results are printed out as one line of a table.

Provided that classification and statistics have been activated, it is possible at any time (i.e. during or after a measuring series) to print out the histogram and the statistics.*
For this.

"Prnt stat" has to be set (△ and ▽) and confirmed with ►

in the instrument configuration. As soon as the printout is complete, the measuring series can be continued.

If only statistical results are to be printed out, we recommend to set all results of the instrument configuration menu "Sel.Prnt" which are not required to "0". This is particularly useful for transferring lots of data. In case of short measuring times and pauses, it may be that the printer receives the data too quickly. This essentially depends on the printing speed and the selected transfer (Baud) rate. If the printer receives the data too quickly, the VMF 2000 indicates the error message "Printer!" and individual characters or lines can be lost.
The printing out of individual values can also be accomplished by activating the input "Accept value into statistics".

The printout of statistical results can also be brought about by activating the input "Print/cancel statistics".

The printing mode is switched off by setting the instrument configuration parameter "Printer" to "0".

- If histograms or statistics are to be printed out quite frequently, we recommend to assign this function to one of the function keys.

6 Annex

6.1 Analogue outputs

The sockets X4 and X5 of the VMF 2000 feature 3 analogue outputs.

Output voltage range: -10 V...+10 V
Internal resistance: 100 Ohm
Load resistance: > 2 kOhm

	X5 socket Pin no.	X4 socket Pin no.	Adjustable sensitivity
Analogue output 1	25	3	0 ... 150 mV/µm
Analogue output 2	24	1	0 ... 150 mV/µm 0 ... 150 V/full sc.
Analogue output 3	23	-	0 ... 150 mV/µm

The voltages across the outputs 1 and 3 are **independent** of the indication range adjusted on the dial-type indicator.

When set to "DAC 2-rel" (see below), output number 2, however, depends on the indication range of the dial-type indicator. At full-scale deflection, the output voltage is equal to the voltage established during the sensitivity adjustment.

Adjusting the sensitivity, the electrical zero point, and the value to be output

- Actuate the key **Konfig.** on the rear of the instrument.

Sensitivity:

- Select "Fac.-DA1" with ∇.
  Use ► , ▲ and ▼ to adjust the sensitivity of output 1.

- Select "Fac.-DA2" and "Fac.-DA3" and set the sensitivity for the outputs 2 and 3 in the same way.

Zero point:

- Select "Adj.-DAC" with ∇. Select one of the analogue outputs (DAC1, DAC2 or DAC3) with ►, and set its electrical zero point with ▲ and ▼. For control purposes, a voltmeter must be connected to the output in question. The zero point will be adjusted in steps of about 5 mV. If one of the keys ▲ or ▼ is kept depressed, the zero point is adjusted "continuously" until releasing the key.

  Note: When adjusting the electrical zero point, no measuring values will be output.

* In the following named "DA" or "DAC", short for "digital-to-analogue converter".

Value to be output:

- Select "Comb.DAC" and actuate ► . With ▲ and ▼ , the following settings can be selected:

  "DAC1 off" The analogue output is inactive.
  "DAC1 C" The result of the combination is output.
  "DAC1 A" The transducer value A is output.
  "DAC1 B" The transducer value B is output.

  If the analogue output is not used, we recommend to select the setting "Off" in order to prevent the computer from wasting time on calculating an unwanted output value.

- Press key ∇ and adjust "DAC2" and "DAC3" as well.

- When depressing ∇ again, "DAC2-fix" or "DAC2-rel" is displayed. With the keys ▲ and ▼ , it is possible to choose one of the following settings:

  "DAC2-fix" The analogue output 2 is not dependent on the adjusted indication range of the dial-type indicator (mV/µm).

  "DAC2-rel" The analogue output 2 is dependent on the adjusted indication range of the dial-type indicator (V/full-scale deflection).

  This possibility only exists for the analogue output 2.

The secondary menu is left by pressing the key △ . The settings are not valid until the secondary menu is left.

6.2 Digital inputs and outputs

Inputs:
Optocouplers with protective resistor and reverse-biased diode for reversed protection.

Limit: I_i < 50 mA
High: V_i > 4.5 V ($I_i = (V_i\text{-}1.2V)/1$ kOhm)
Low: V_i < 2.5 V ($I_i = V_i/1.5$ kOhm)

For activating BCD switches, a resistor of 220 Ohm/1 W has to be connected in series to the output.

Outputs:
Optocouplers with Darlington output transistor and reverse-biased diode for reversed protection.

Limits: V_{CE} < 35 V, I_C < 80 mA
High: V_{CE} < 2 V, I_C> 30 mA (typ. 45 mA)

The collectors of the output transistors and the cathodes of the input LED's are combined to form groups which are assigned to common contacts of the socket. Thus, the groups can be isolated electrically.

Note: The electrical isolation does not fulfil safety requirements, it only serves for metrological purposes (e.g. for avoiding earth loops).

All signals have a positive logic and are "high active", i.e. an active function (= "On") causes a current to flow through the optocoupler.

Transferring the input information:

The inputs are sampled at a rate of about 1.6 ms. 8 inputs are internally arranged to form a group (1 Byte). In order to suppress interferences effectively, a changed input signal is ignored unless the logic level on all inputs of a group was stable during 16 ms, i.e. for 10 successive samples.

Group 1: Select indication range R1in ... R7in
Accept master value

Group 2: BCD-Hold
Synchronize (measuring/reference instrument)
Symmetry
Accept value into statistics
Cancel/print statistics
Fade out zero setting value
Accept master value
Fade out master value

Group 3: Zero setting
Accept upper tolerance limit
Accept lower tolerance limit
Cancel error signal

BCD output (X7/1 ... X7/10, X7/19 ... X7/27, X7/34 ... X7/44)

The BCD output consists of 21 lines which serve for outputting five digits and a sign. Depending on the configuration, either the master value or the currently valid measuring value are output.
The individual digits are BCD coded (8-4-2-1), the least significant digit being D1out - C1out - B1out -A1 out.

Configuration	Output via the BCD outputs	Output rate
Meas. val.	Measuring value (actual value)	5 values/s (200 ms)
Master value	Master value	only in case of changes

Changing the configuration:

1. Actuate the key **Konfig.** on the rear of the instrument.

2. Use ∇ or △ to select one of the parameters "Meas. val." or "Master val." and ▲ or ▼ to change them.

BCD-Hold (X7/X17)

By activating this input signal, the output value remains unchanged, while the internal measuring value processing continues uninfluenced. This function should be used when transferring data via the BCD outlet to a connected instrument.

BCD input (X7/13 ... X7/16, X7/46 ... X7/49)

BCD data are transferred to the VMF 2000 in the multiplex mode. Eight input lines allow to read in two digits simultaneously. The strobe outputs S1, S2 and S3 indicate the digits that are being input at the moment.

S1 : sign and first digit (most significant digit)
S2 : second and third digit
S3 : fourth and fifth digit (least significant digit)

The most significant BCD coded digit is reserved for the sign (D2in-C2in-B2in-A2in together with S1):

Line "A2in" inactive (= no current flowing) : positive sign
Line "A2in" active (= current flowing) : negative sign

The strobe pulses S1, S2 and S3 which are created by the VMF 2000 feature a pulse width of about 100 ms. There is a pause of 50 ms between the individual strobe pulses. At the latest, the BCD data have to be valid about 100 µs before reaching the negative flank of the strobe pulse. The data can be fed in directly via BCD coded switches. In case data are to be read in from computers or intelligent control circuits, the transfer of the BCD data must be synchronized with the strobe pulses generated by the VMF 2000.

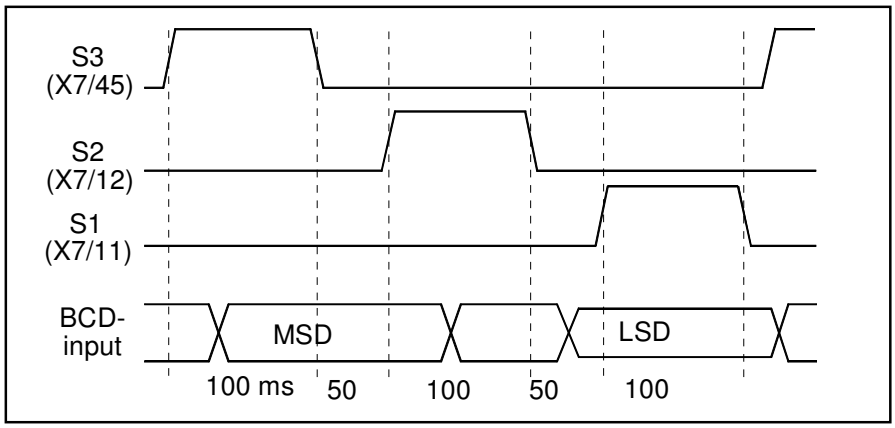


Fig. 8
Time-varying assignment of the strobe inputs

Via the BCD inputs, either the master value or the lower or upper tolerance limits can be input.
For activating BCD switches, a resistor of 220 Ohm/1 W has to be connected in series to the output.

Accepting the master value (X7/50)

The master value must be applied to the BCD input for at least one multiplex period (3 * 150 ms). After having activated the input "Accept nominal value", the VMF 2000 employs the read-in value as the new master value.
The VMF 2000 always assigns a negative sign to the master value, irrespective of the sign fed in via the corresponding input line.

Accepting the upper and lower tolerance limit (X8/46, X8/47)

The BCD value for the upper or lower tolerance limit must be applied to the BCD input for at least one multiplex period (3 * 150 ms). After activating the input signal "Accept upper tolerance limit" or "Accept lower tolerance limit", the entered value (with sign) will be used as the new tolerance limit. When activating the "Accept ..." signal, the read-in value will be output via the BCD outlet for check purposes.

Fading out the master value (X8/13)

For as long as this input signal is active, the master value will not be considered for the result calculation. This function has effects on all output channels, i.e. on the indications as well as the analogue outputs. The letter "S" only lights up in the text indication if the master value is displayed.

Example:

Input "Fade out nom. value"	Result of the combination	Numerical display	Text indication
off (inactive) on (active)	946.0 µm 946.0 µm	- 54.0 µm 946.0 µm	S 1000.0 1000.0

Master value equals presetting (X8/6)

This output signal is active, whenever the value across the BCD inputs equals the master value which was either adjusted with signal "Accept nominal value" or entered via the keyboard.

Fading out the zero setting value (X8/44)

When calling up this function, the stored zero setting value will be set to "0", i.e. a preceding zero setting process will be cancelled. The stored zero setting value will be deleted.

Example:
The current zero setting value is 57.6 µm.

Indication before "Fading out the zero setting value":
82.7 µm - 57.6 µm= 25.1 µm

Indication after "Fading out the zero setting value":
82.7 µm - 0.0 µm = 82.7 µm

Enter calibration value (X5/5)

The calibration value must be applied to the BCD input for at least one multiplex period (3 * 150 ms). After activating the input signal "Enter calibration value" the entered value will be used as the new calibration value. The calibration value is always entered with positive sign.

Zero setting (X8/45)

This input signal adjusts the current indication value to zero or to the master value, respectively. The zero setting is confirmed via the X8/8 output and is performed as long as the X8/45 input is activated.

The VMF 2000 sets the zero setting value to the combination result.
The VMF 2000 subtracts the zero setting value from the combination result and adds the master value.

Combination result – Zero setting value + Master value = Indication value

Example:
Before "Zero setting": 82.7 µm - 0.0 µm + (-100 µm) = - 17.3 µm

After "Zero setting": 82.7 µm - 82.7 µm + (-100 µm) = -100 µm

Confirming the zero setting (X8/8)

This input signal confirms the "Zero setting" signal.

* The function "Zero setting" sets both measuring channels (transducer A + transducer B) to zero. The individual transducer values can be output via the analogue outputs or can be inquired via the computer interface with M98/M99.

** (transducer A - zero setting value A) + (transducer B - zero setting B) + Master value = indication value
Example:
Before "Zero setting":
(43.7 µm - 0.0 µm) + ((-22.3 µm) - 0.0 µm) + (-100 µm) = -78.6 µm
After "Zero setting":
(43.7 µm - 43.7 µm) + ((-22.3 µm) - (22.3 µm)) + (-100 µm) = -100 µm

Selecting the indication range of the dial-type indicator (X8/14 ... 17, 48 ... 50)

The indication range of the dial-type indicator can be selected via the inputs "R1in" to "R7in". Since the VMF 2000 features a total of nine indication ranges, the assignment of the control inputs to the indication ranges depends on the instrument configuration.

Configuration	R1in	R2in	R3in	R4in	R5in	R6in	R7in
MR. * 1	1	3	10	30	100	300	1,000
MR. * 10	10	30	100	300	1,000	3,000	10,000

Explanation: With the configuration "MR.*1", signal "R4in" adjusts an indication range of 30 µm whereas a range of 300 µm will be adjusted with the same signal, if the configuration "MR. *10" is adjusted.

If none of these inputs is activated when switching on the VMF 2000, the setting stored in the EEPROM is used.

The range of indication within one configuration setting can be changed by actuating the key ▲ or ▼ .

Changing the configuration:

1. Actuate the key **Konfig.** on the rear of the instrument.
2. Select one of the configuration parameters "MR.*1" or "MR.*10" with △ or ▽ .
3. Select the range of indication with the keys ▲ and ▼ .
4. If necessary, save the range setting permanently by means of the function "Save".

Outputs for checking the indication range setting of the dial-type indicator (X8/1 ... 4, 34 ... 36)

Via the outputs "R1out" to "R7out", the indication range setting for the dial-type indicator can be output. Here, the assignment between the indication ranges and the outputs is also dependent on the instrument configuration.

Configuration	R1out	R2out	R3out	R4out	R5out	R6out	R7out
MR. * 1	1	3	10	30	100	300	1,000
MR. * 10	10	30	100	300	1,000	3,000	10,000

Explanation: With the configuration "MR.*1", the output "R4out" indicates a range of 30 µm, while it indicates 300 µm for the configuration "MR. "10".

Symmetry (X8/11)

This input signal starts the symmetry process. The signal " Symmetry complete" will be switched off whenever a new symmetry process starts. It will be switched on again as soon as the symmetry process is complete.

The symmetry process can be aborted by activating the input signal " Symmetry" again. In this case, the signal " Symmetry error" (X5/18) is output.

The balancing function can also be started via the configuration catalogue parameter "Symmetry".

Symmetry complete (X8/5)

This signal indicates the termination of a successful symmetry process.

After switching on the VMF 2000, this signal is not active. It will be switched on after the first successful symmetry process and remains to be switched on until the next symmetry process starts.

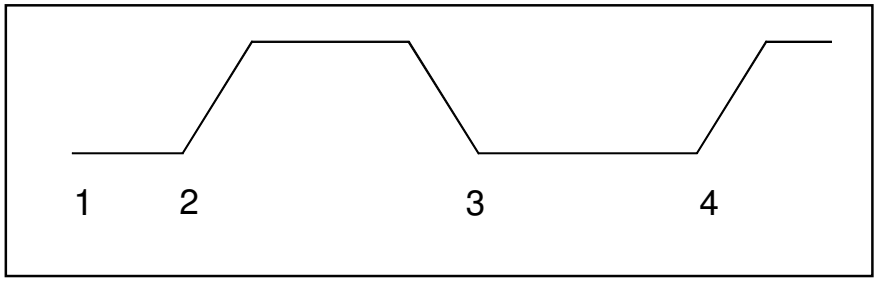


Fig. 9
Course of the signal " Symmetry complete"

1 State when switching on the instrument
2 1st symmetry complete
3 2nd symmetry started
4 End

S*ymmetry* error (X5/18)

This output signal is cancelled when starting the symmetry process and activated when aborting the function.

Transducer A or B overloaded (X8/7)

This signal will be activated, whenever one of the two analogue-to-digital converters is overloaded. This is the case, if the adjusted measuring range is exceeded by about 15 %. As soon as the overload is removed, the signal disappears.

Reject (X8/38), Rework (X8/37)

These two outputs signal the condition of the three pilot lamps for tolerance monitoring. In case the result lies within the preset tolerance limits or tolerance indication is switched off, the two outputs are inactive.
The assignment between the pilot lamps and the exceeded tolerance limits is not fixed, but changes with the type of measurement (internal or external). Thus, the valid assignment has to be adjusted in the instrument configuration (see section "Tolerance monitoring").

Measuring value in case of external meas.	internal meas.	Active output	Pilot lamp
< low. Tol.	> up. Tol.	Reject	red
> up. Tol.	< low. Tol.	Rework	yellow
low. Tol. < meas. value < up. Tol.		-	green

Blanking out a disturbance (interference) (X8/39)

Here, the detection of a disturbance and the start of the blank-out phase is signaled. For as long as the disturbance takes place, the signal will be prolongated by multiples of 1.6 ms. After the disturbance disappeared, the signal (and thus the blank-out time) will be extended by the holding time (see section 6.5 "Blanking out disturbances").

SI-Error, Error signal interference blanking (X8/41)

If the blank-out time exceeds the adjusted (error) delay time, the "SI-ERROR" signal (error signal for interference blanking) will be activated. This signal remains to be active until the signal "Cancel error signal" is sent (see section 6.5 "Blanking out disturbances").

Cancelling the error signal (X8/9)

Via this input, the "SI-Error" signal is cancelled.

Transducer checking (X5/6)

This signal activates the transducer checking. The transducer checking is active until the signal is reset. When the transducer checking is deactivated, the " Transducer checking error signal" (X5/19) is automatically reset.

Transducer checking error signal (X 5/19)

If the signal difference of a transducer after the preset time (tk[s]) is smaller than the path (s(k)), the error signal X5/19 is set. If the function is activated, the output can be reset via the input "Cancelling the error signal" (X8/9).

Print/cancel statistics (X8/43)

This input signal starts the printing out of statistical results via the serial interface "X10".
In case the input signal "Accept value into statistics" is activated simultaneously, all statistics registers are deleted. Therefore, printing out the results can be repeated as often as desired (e.g. after paper jam) provided that the input signal "Accept value into statistics" is not activated simultaneously.

Accept value into statistics (X8/42)

When activating this input, the measuring time is started according to the configuration setting ("STRT man"; "STRT Tm"; "STRT Tp").

If "STRT man" or "STRT Tp" has been chosen, the measuring time or the interval measurement is terminated when deactivating this input.
After the measuring time has run out, the result selected under "Sel.stat" is accepted into the statistics. The measuring result is printed out if the printer interface has been activated in the configuration settings.

If "STRT Tm" has been chosen, the input has to be activated at least until the preset measuring time has run out. If the input is deactivated before the measuring time has run out, the measuring time will be aborted and the measuring value will not be accepted into the statistics.

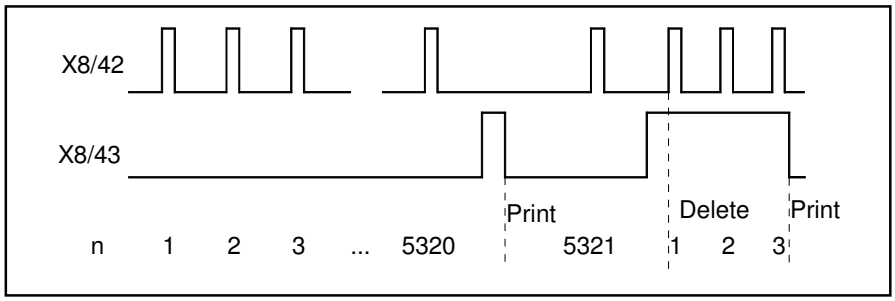


Fig. 10
Function of the input X8/42

Synchronization (start meas./ref.) (X8/10)

Via this input signal, the measuring/reference function, i.e. the zero point correction of a connected measuring instrument, is activated on the reference instrument (see section 6.6 "Zero point correction by means of the measuring/reference function").

Synchronization successful (X5/17)

Synchronization error (X5/16)

Both signals are cancelled when starting the function "Synchronize". In case the harmonization of the zero points is successful, the X5/17 signal is activated. If an error occurs during the harmonization or if the calculated correction value exceeds the adjustable parameter "max.Corr.", the output X5/16 is activated.

6.3 Adjusting the sensitivity

Deviations from the nominal sensitivity can be corrected for each transducer by means of "Factor A" or "Factor B", respectively.

Besides the manual adjustment described in section "Correction factors", the VMF 2000 also enables the automatic calculation and adjustment of correction factors.
The automatic process is based on the comparison between the values assessed by the VMF 2000 (which, as the case may be, have to be corrected) and a known increment which may be given, for example, by a gauge block.

Gauge block table

Before adjusting the sensitivity, it is indispensable to enter the height of at least two gauge blocks into the gauge block table. One of the input values may even be zero. The table may comprise up to 10 gauge block heights, which makes it superfluous to specify gauge block heights whenever readjusting the sensitivity.

Entering values into the gauge block table:

1. Actuate the key **Konfig.** on the rear of the instrument.

2. Use the keys ∇ and △ to select the configuration parameter "G. block" and press key ► thereafter. The value for gauge block 1 will be displayed.

3. If required, the value indicated for gauge block 1 can be modified by means of the keys ► , ▲ and ▼ .

4. Depress ∇ . The value for gauge block 2 will be displayed.

5. Enter the value for gauge block 2 and, as the case may be, for further gauge blocks.

6. Either press **RESULT** to return to the basic state, or press △ to return to the main catalogue and save the settings with "Save".

Adjusting the sensitivity:

1. Actuate the key **Konfig.** on the rear of the instrument.

2. Select the function "Sensit." with ∇ or △ and start it with ► .

3. Now, "G. block 1" will be displayed together with the value entered into the gauge block table. By using the key ▲ or ▼ , a different gauge block can be chosen from the gauge block table. After having placed this gauge block into the measuring device, the first measurement can be started with ► .

4. As soon as the measurement is complete, the VMF 2000 offers another gauge block. Again select the desired gauge block, insert it into the measuring device, and start the second measurement with ► .

On the base of the two measuring results and the two nominal values, the VMF 2000 calculates a correction factor "C" with which "Factor A" and "Factor B" will be multiplied.

$$C = \frac{\text{Gauge block 2 - Gauge block 1}}{\text{Measuring value 2 - Measuring value 1}}$$

As can be seen from the equation, only the differences in size are considered. The input of the absolute gauge block values thus only serves for comfortable operation.

"Factor A" and "Factor B" will be multiplied by the above-mentioned correction factor "C":

Factor A (new) = Factor A (old) * C
Factor B (new) = Factor B (old) * C

In case of the transducer combinations +A, -A, +B and -B, only the sensitivity of the selected transducer will be corrected, i.e. either "Factor A" or "Factor B".

In case of the transducer combinations
+A +B,
-A -B,
+A -B,
-A +B,

i.e. in case sum or differential measurements are to be carried out, the sensitivity of both transducers will be corrected ("Factor A" and "Factor B").

This, however, does only render correct results, if the transducers symmetry has been balanced before the sensitivity was adjusted.

6.4 Balancing the Symmetry

Transducers and amplifier feature production-based sensitivity tolerances. These tolerances cause a system-inherent error which is proportional to the common deflection of the two transducers (above all in case of sum measurements). This error manifests itself for constant differential signals (touching transducer tips, master measurement) in the form of a continuously increasing or decreasing indication value, when moving the transducers together over the entire measuring range. This error can be corrected by adapting "Factor A" and "Factor B".

Balancing the Symmetry manually

1. Determine the stroke of the transducers. For this, select the transducer combination "+A" or "+B". Afterwards, the transducers have to be moved together from one stop to the other and the values indicated in the stop positions must be noted. On the base of these values, the stroke will be calculated.

   Example:

lower stop	: +A	= -1,980 µm
upper stop	: -A	= 1,950 µm
stroke	:	1,980 µm - (-1,950 µm) = 3,930 µm

2. Adjust the transducer combination for sum measurements ("+A +B"). Together move the transducers from stop to stop and note the indicated values with the correct sign. Here, the direction of movement has to be taken into account as well. Reading off the values will be simplified, if in one stop position the indication is set to zero with the keys ☗ and ⊢O⊣.

   Example: For a deflection of 3,930 µm, the indicated value changes by -25 µm. Here, transducer A was deflected in the positive, transducer B in the negative direction. The change of -25 µm shows that the transducer moved in negative direction, i.e. transducer B, is too sensitive. The error relative to the entire stroke is:

   $$\frac{-25\ \mu m}{3930\ \mu m} = 0{,}006361$$

   This means that transducer B features an oversensitivity of 0.64 % or, the other way round, transducer A features an insensitivity of 0.64 %.

   Balancing can now be achieved by either changing "Factor A" or "Factor B":

   Factor A (new) = Factor A (old) * 1.006361

   or

   $$\text{Factor B (new)} = \frac{\text{Factor B (old)}}{1.006361}$$

Balancing the symmetry automatically:

Balancing the symmetry automatically is based on the manual process. All necessary measurements, calculations and settings are automatically carried out by the VMF 2000. It only has to be made sure that the transducers are deflected simultaneously.

Balancing the symmetry automatically can be started either via the "Symmetry" signal, the configuration catalogue function "Symmetry" or the computer interface (P53/P59).

1. Depress the key **Konfig**. on the instrument's rear.

2. Use the key ∇ or Δ to select the function "Symmetry" and press ► to start it.

3. Repeatedly move both transducers together from stop to stop. For every second inversion of the direction of movement, a horizontal line will be indicated on the numerical display.

Throughout the first phase, the range to be balanced will be determined. The VMF 2000 recognizes the range limits by the inversion of transducer signal A (peak detector). First the positive, than the negative deflection of transducer A will be assessed. The difference between the peaks must be

>500 µm for the measuring range ± 2,000 µm or
> 50 µm for the measuring range of ± 200 µm.

This process will be repeated and the largest deflection reduced by 2.5 % will then be assumed as travel limit.

In a second phase, the measuring values for determining the correction factor will be assessed. For this, the transducer signal must exceed the range limits determined before. After a 200 ms wait, the mean value of the transducer signals will be acquired for each transducer individually during the next 400 ms. These measuring values are the base of the correction factor calculation:

$$\text{Factor A (new)} = \text{Factor A (old)} * \frac{\text{(Meas. value B) max - (Meas. value B) min}}{\text{(Meas. value A) max - (Meas. value A) min}}$$

The second phase as well will be repeated and a new correction factor calculated, until "Factor A" and "Factor B" differ by less than one tenthousandth.

After successfully completing the symmetry process, the sensitivities of the two transducers are harmonized with respect to each other. The output signal "Symmetry complete" (X8/5) is activated. The absolute sensitivities, however, are only correct, if the sensitivity of transducer B was adjusted correctly before starting the balancing process.

In case the balancing process is aborted by activating the input signal " Symmetry " again, the output signal " Symmetry error" (X5/18) is set.

The " Symmetry complete" (X8/5) and " Symmetry error" (X5/18) outputs are also set or cancelled when the synchronization is started via the keys or the computer interface (P53).

6.5 Blanking out disturbances

In case of temporary disturbances (e.g. the lifting of a transducer), blanking is to prevent the faulty signal to be fed to the control circuit via the analogue outputs. The blanking function will be activated whenever the adjusted signal increase speed is exceeded. The activation of this function has the effect that the measuring value which was acquired immediately before the disturbance appeared is continued to be sent for a longer time.
After the end of an adjustable holding time, the current measuring value will be output again. The holding time is the time which elapses between the end of the disturbance and the continuation of the measuring value output.
During blanking out, the output signal "Blanking out a disturbance" will be active.
If the blanking time exceeds the error indication delay time, the error is signalled via the output "Blanking out a disturbance". After having eliminated the disturbance, this signal must be cancelled by another, namely "Cancel error signal".
Please note that blanking out does only have an effect on the three analogue outputs.
Blanking out can be adjusted via the following parameters:

Parameter	Text indication	adjustable range
max. allowed signal increase speed	Slope	0 ... 999 µm/ms
Holding time	SI-Hold	0 ... 999.9 ms
(Error) Indication delay time	SI-ERROR	0 ... 999.9 ms

At a holding time of 0.0 ms, blanking out is switched off.

Setting the parameters:

1. Actuate the key **Konfig.** on the rear of the instrument.
2. Select the parameter with the key ∇ or △ and adjust it with ▲, ► and ▼.
3. Choose further parameters with ∇ or △ or leave the parameter selection with **RESULT**.

6.6 Zero point correction by means of the measuring/reference function

This function enables to correct the electrical zero point of every measuring instrument in a control circuit by means of a second VMF 2000 operating as a reference instrument. Only during tuning, the reference instrument operates parallely to the measuring instrument.
The electrical zero point of the measuring instrument, which may change due to temperature changes, transducer wear, etc., is to be corrected by comparison with the zero point of a reference instrument. Here, the reference instrument is presumed to keep stable, and both instruments to receive equal though time-delayed signals. For determining the zero point, both instruments calculate the mean value of their transducer signals over a given period of time. The reference instrument sends its mean value to the measuring instrument which corrects its zero setting value accordingly.
Data between measuring and reference instrument are transferred digitally via the electrically isolated serial interfaces X6. For correcting other instruments, it is also possible to configure the reference instrument in such a way that the mean value is output via an analogue output.

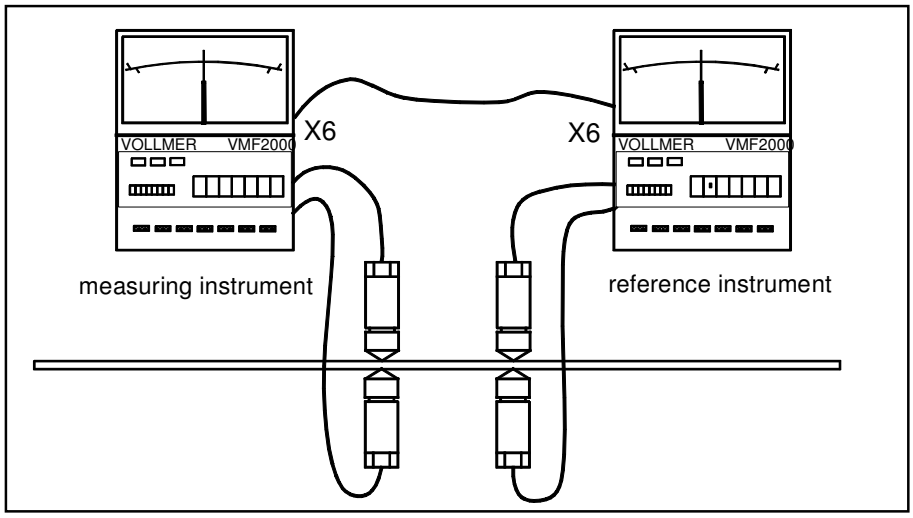


Fig. 11
Zero point correction by means of a reference instrument

Correcting the zero point of a VMF 2000

The two instruments must be connected via their "X6" sockets (see figure of the connecting cable in section 6.10). Data transfer between measuring and reference instrument is accomplished via this interface.
In order to harmonize the zero points of the two instruments, the "Synchronize" signal of the reference instrument (socket X8/10) will be activated. Whenever the input "Synchronization" is activated, the "Meas./ref." function is restarted irrespective of the reference or measuring instrument. The reference instrument now begins to communicate with the measuring instrument via the "X6" interface and starts the mean value determination. At the same time, the mean value determination of the reference instrument commences. The process ends

- when the "Synchronize" signal is deactivated (for "Tman")
  or
- when the measuring time Tm is ended (for "Tm").

The operating mode "Tp" corresponds to the operating mode "Tman".

The reference instrument sends the established mean value to the measuring instrument. The measuring instrument now corrects the so far valid zero setting value such that it indicates the same value as the reference instrument:

Zero setting value (new) =
Zero setting value (old) - (Mean value ref.ins - Mean value meas.ins)

The "Synchronization successful" (X5/17) output is activated when the measuring instrument is set to zero during the correction process (input of the measuring value).
The maximum allowed correction can be limited by means of the parameter "max.Corr." (in µm). In case the calculated correction value exceeds this parameter, no correction is accomplished and the output signal "Synchronization error (X5/16)" is activated.
The speed with which the signal is set to the new corrected value can be adjusted by means of the parameter "s corr" (in µm/s).

Correcting the zero point of any other measuring instrument

If the parameter "max.Corr" is set to "0.0" in the reference instrument, the reference instrument outputs the mean value via the analogue output 3. This voltage can be used as a correction value for any other measuring instrument.

Taking the measuring point spacing into account

The delay time between the transducer signals of the two instruments is a function of transport speed and measuring point spacing (in direction of transport). For sufficiently long measuring times, the time delay of the measuring signals has practically no influence on the mean value. Thus, keying in the transport speed and the measuring point spacing becomes superfluous, which simplifies operation.

The error caused by the measuring point separation can be compensated for by the time-delayed start of the value determination by the instrument receiving the time-delayed signal. Here, the delay time T_d of the instrument is adjusted to the value:

$$T_d = \frac{\text{Measuring point separation}}{\text{Transport speed}}$$

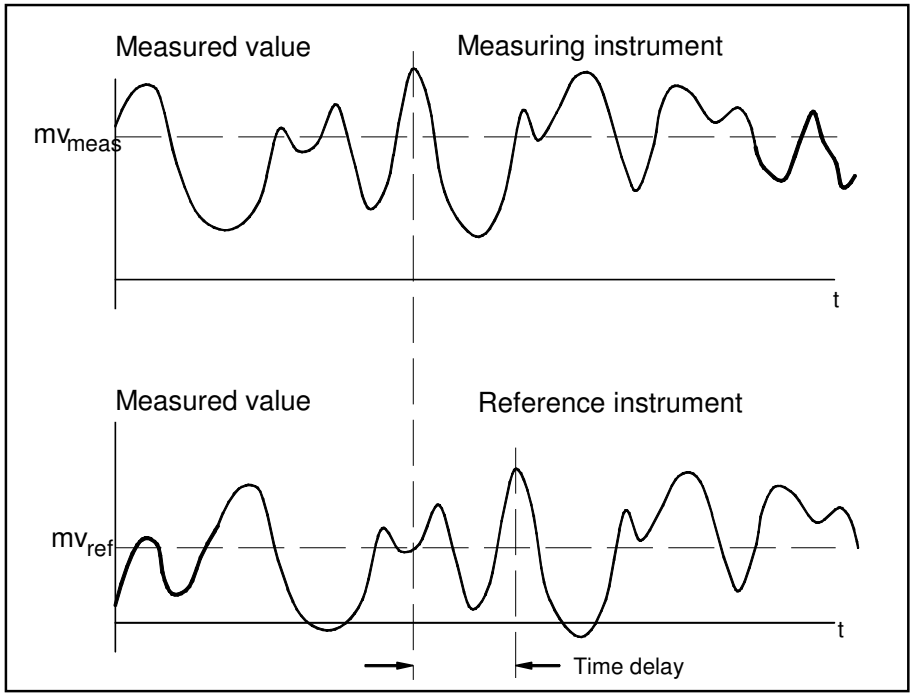


Fig. 12
Locally displaced measuring points (in direction of transport) cause a time delay between corresponding measuring values. The delay time can be calculated by the equation mentioned above. It is taken into account by entering a Td value into the reference instrument (Mean = mean value).

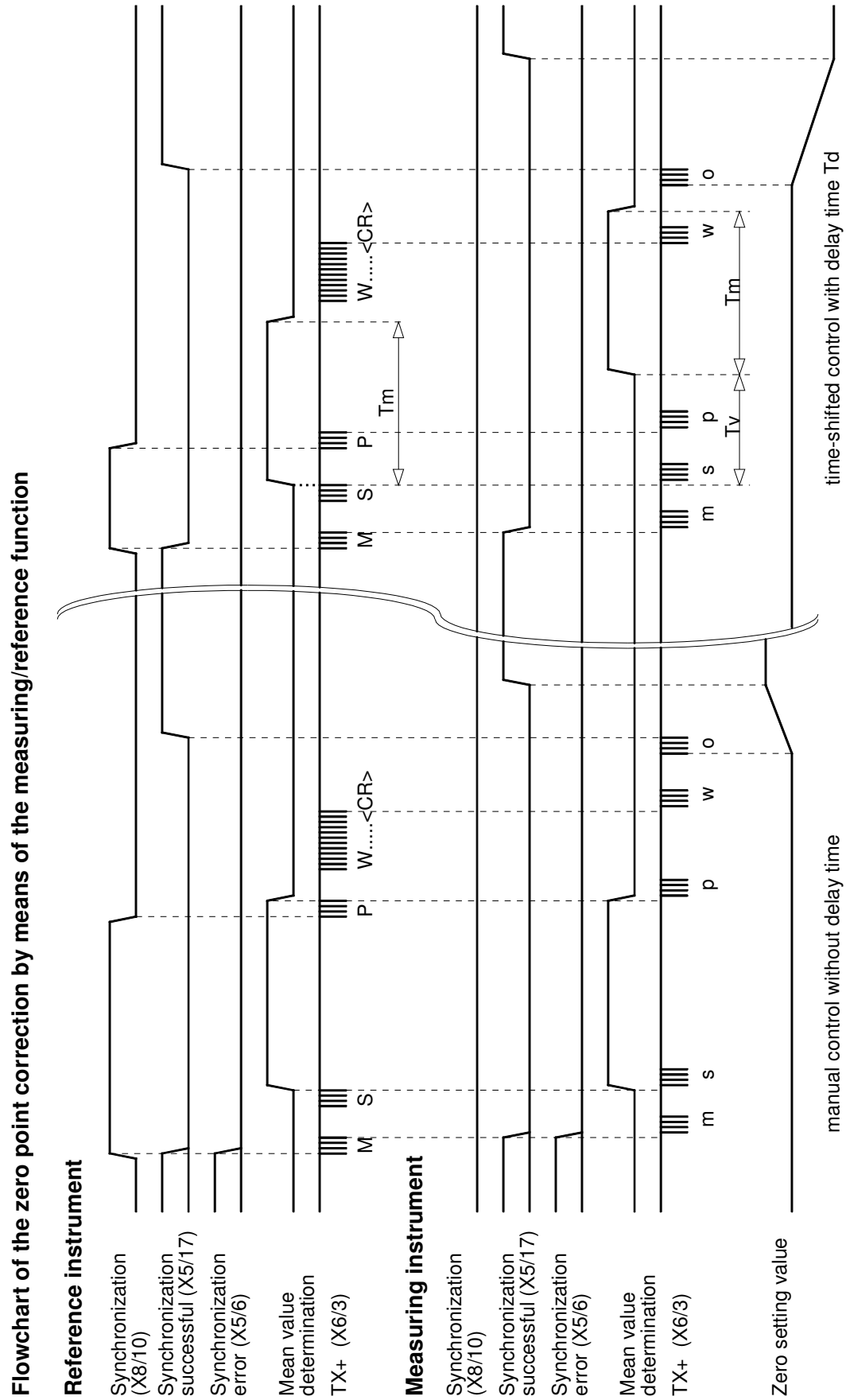


Fig. 13 Flowchart of the zero point correction by means of the measuring/reference function

6.7 Transducer checking

The " transducer checking" function outputs an error message, if the path covered by one of the transducers after the preset time (Tk[s]) is smaller than the path s(k). This serves for example to recognize if one of the transducers is sticking.

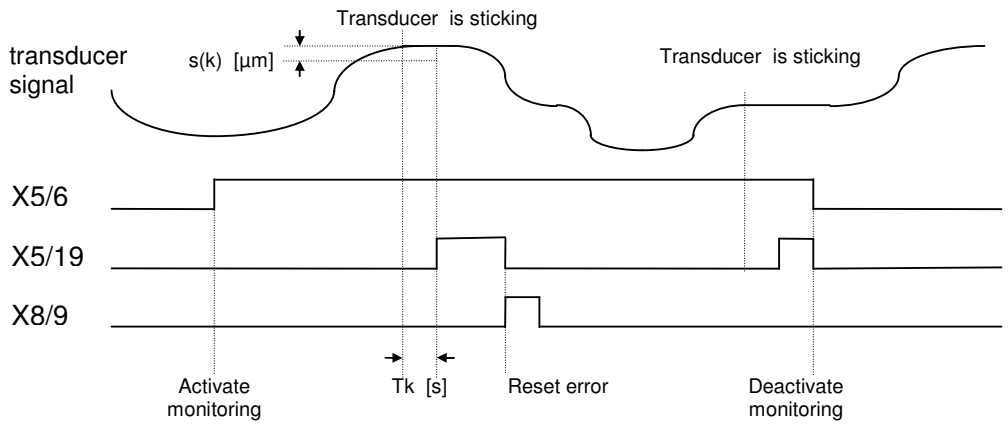
The signal differences of the individual transducers are evaluated for a preset time. If the signal difference of one of the transducers after the preset time is smaller than the path s(k), the error signal X5/19 is set.

The function is activated and deactivated via the input X5/6. When deactivating the function, the error signal is automatically reset.

If the function is activated, the output can be reset via the input "Cancelling the error signal" (X8/9).

The function can be switched off by entering 0 for s(k) or Tk[s].

Flow process diagram



Setting range
s(k) : 0 µm ... 99.9 µm
Tk[s] : 0 s ... 9.999 s

6.8 Linearization of transducer characteristics

The VMF2000 can linearize the characteristics of individual transducers. The linearization is valid only for one individual transducer. After a replacement of the probe it is necessary to linearize the new transducer once.

Linearization procedure

For each transducer a table is created which contains a correction value each 100 µm approximately. These correction values are subtracted from the measured transducer values at the respective position. Values in between the correction points are interpolated.

Manual entry of correction data

Each transducer has to be linearized individually. For that purpose the other transducer has to be replaced by an adjustable stop, for example a micrometer. The reference for the linearization is a gage block. Before the linearization procedure starts make sure that no offset has been introduced by the function "zeroing" and the transducer travel is from +2100 µm to – 2300 µm.

The size of the gage block has to be entered in the configuration as parameter „**G. BL. 10**" (= gage block 10).
If necessary the old linearization data has to be cleared (see: „clear linearization table)
The linearization procedure is started via the function „**AutoCorr**" in the menue „**ProbCorr**".
Next the respective channel and direction (sign) has to be selected, for example "**Corr A+**" as the linearization has to executed separately for channel A and B and separately for the „plus" and „minus" direction.
The linearization may start at any point inside the measuring range but always with the selected polarity.
It is recommended to start with the first point close to the transducers "zero" .

1. On the left side of the display appears „**M1 0**" und on the right the actual transducer position.

2. Set transducer to approx. 0.0 without gage block.

3. Accept M1 with ⇒ .

4. On the display appears „**M2 300**" (for example, if 300µm has been entered as "**Gage block 10**")

5. Insert gage block between adjustable Stop and transducer. Don't move the spindle position of the adjustable stop. Accept M2 with ⇒.

6. The inclination of the curve is calculated and all entries of the linearization table are corrected until the end of the measuring range.

7. Again in the display appears „**M1 0**" . The gage block has to be removed and the transducer touches the adjustable stop. The adjustable stop now has to be moved to that position which the transducer had before with the gage block in this example 300 µm.

8. Repeat step 3 to 6 up to the positive end of the measuring range. The correction of each step starts with the correction point following the measuring value „M1"

9. After the positive part of the curve has been linearized the same procedure has to be repeated for the negative part of the curve. Please note in case of the negative part the first measuring has to be done **with** gage block and the second measuring **without** gage block

The linearization may be repeated at any time at different points in order to touch up the correction of the curve.
The precision of the calculation of the inclination is only influenced by the difference of the two measurements with and without gage block, not by the absolute value of the measurement.

Note : **If the error-message „Error“ appears when leaving the configuration at least one table entry has been calculated „out of range“. The specific entry has to be decreased or the table has to be cleared by „Clear A+“ or „Clear A-„.**

The functions necessary for the linearization are called via the configuration menu „ProbCorr“.

ProbCorr ⇒ Entry of the linearization function

- A -xxxx.x
- A -yyyy.y
- ... Correction table for channel A. With the right arrow keys ⇑ and ⇓ the correction points can be selected and if necessary changed with ⇒.

⇓

- B -xxxx.x
- B -yyyy.y
- ... Correction table for channel B

⇓

AutoCorr ⇒

- Korr A+ ⇒ Linearization of transducer A with gage block in + direction
- M1 0 ⇒
- M2 xxx ⇒
- M1 0 ⇒
- ...

- Korr A- Linearization of transducer A with gage block in - direction
- M1 0 ⇒
- M2 xxx ⇒
- M1 0 ⇒
- ...

- Korr B+ Linearization of transducer B with gage block in + direction
- M1 0 ⇒
- M2 xxx ⇒
- M1 0 ⇒
- **...**

- Korr B- Linearization of transducer B with gage block in - direction
- M1 0 ⇒
- M2 xxx ⇒
- M1 0 ⇒
- **...**

⇓

Clear ⇒ **Clear A+** Clears positive part of the correction table for transducer A

⇒ **Clr ? ⇓** Confirm with ⇓ or abort with „Result“

⇓

Clear A- Clears negative part of the correction table for transducer A

⇒ **Clr ? ⇓** Confirm with ⇓ or abort with „Result“

⇓

Clear B+ Clears positive part of the correction table for transducer B

⇒ **Clr ? ⇓** Confirm with ⇓ or abort with „Result“

⇓

Clear B- Clears negative part of the correction table for transducer B

⇒ **Clr ? ⇓** Confirm with ⇓ or abort with „Result“

⇓

Print ⇒ Prints the correction table for A und B via printer port

6.9 Instrument configuration

The instrument configuration level is reached by pressing the key **Konfig.** on the rear of the instrument or, provided that the settings are not blocked by means of "Code", by simultaneously actuating the keys **F1** and **F2**.

Now, the desired parameter can be selected with key △ (forward scrolling) or ▽ (backward scrolling).

There are three possibilities for setting or changing parameters:

1. Parameters with several defined adjustments.
   Adjust with ▲ or ▼ . Return with △ or ▽ .
2. Parameters to which numerical values are to be assigned.
   Adjust with ► , ▲ , and ▼ . Return with △ or ▽ .
3. Parameters with several assigned sub-parameters.
   Adjust with ▽ , ► , ▲ , and ▼ .
   Return with △ .

As a rule, the instrument configuration level is left by pressing the key **RESULT**. Directly executed functions form an exception to this rule, for they automatically entail leaving the instrument configuration.

List of configuration parameters

The following list shows the standard configuration to which the VMF 2000 is adjusted on delivery.

Parameter	Indication
Tolerance monitoring	Tol. off
Selecting the result of tolerance monitoring	Sel. tol
Hysteresis	Hystere.
Number of classes	Classes
Measuring range	MR. ± 2000
Transducer combination	C:+A+B
Adjusting the sensitivity of transducer A	Factor A
Adjusting the sensitivity of transducer B	Factor B
Measuring value integration time	Ti [ms]
Selecting the result to be indicated	Sel. res
Indicating the combination	DispCOMB
Indicating the statistics	DispSTAT
Selecting the mode of indication	Sel. ins
Resolution of the numerical display	Resol.
Unit	Unit
Language	English
Brightness of the display	Bright. 4
Calibrating the dial-type indicator	Cal.inst
Statistics	Stat.off
Selecting the statistical results	Sel.stat
Number of results to be evaluated statistically	n max
Statistical printout	PrntStat
Deleting the last statistical result	Clr xn
Deleting the statistics completely	Clr stat
Controlling the measuring time Tm	STRT man
Delay time	Td [s]
Measuring time	Tm [s]
Pause time betw. cyclical repet. of meas. runs	Tp [s]
Input/output parameters (computer interface)	I/O para
Printer parameters (printer interface)	Prntpara
Gauge block table	G.block
Probe correction (linearization)	ProbCorr
Sensitivity	Sensit.
Transducer symmetry	symmetry
Max. allowed offset correction (measuring/reference function)	max.corr.
Setting speed of offset correction	corr.v
Sensitivity adjustment of the analogue output 1	Fac.-DA 1
Sensitivity adjustment of the analogue output 2	Fac.-DA 2
Sensitivity adjustment of the analogue output 3	Fac.-DA 3
Zero point setting of the analogue outputs 1 ... 3	Adj.-DAC
Selecting the value to be output via DAC 1 ... 3	Comb.DAC
Max. allowed blanking increase speed	Slope
Holding time	SI-Hold
Max. allowed error indication delay time	SI-ERROR
Min. path for transducer checking	s (k)
Time stretch for transducer checking	Tk [s]
Sel. val. to be output via BCD output (mas./act. val.)	Nom. val.
Indication range setting for the dial-type indicator	MR. *10
Input/output test	IO-Test
Configuration lock	lock off
Configuration printout	PrntConf
Standard configuration	s.config
Saving the settings	Save

Configuration parameter	Menu (Indication)	Settings /Indication		Explanations Parameter settings 1 = on; 0 = off
Tolerance monitoring	**Tol. off**	Tol. off		Tolerance monitoring switched off. It is not possible to adjust upper or lower tolerance limits for tolerance monitoring.
		Tol –>I I<–		Tolerance monitoring switched on: *external measurements*
		Tol I<– –>I		Tolerance monitoring switched on: *internal measurements*
				With tolerance monitoring switched on, it is possible to adjust tolerance limits. During measurement, three different results can be output: - Reject (red pilot lamp), - Rework (yellow pilot lamp), - Accept (green pilot lamp). For tolerance monitoring, it is indispensable to determine the result to be monitored. This can be done via parameter "Selecting the result for tolerance monitoring" (Sel. tol).
Selecting the result for tolerance monitoring and classification	**Sel. tol**	Combine	0/1	Measuring result acc. to transducer combination
		MAX	0/1	Maximum value of a dynamic measurement
		MIN	0/1	Minimum value of a dynamic measurement
		(MX+M)/2	0/1	Mean of the maximum and minimum value of a dynamic measurement
		MAX-MIN	0/1	Difference between the maximum and minimum value of a dynamic measurement
		MEAN	0/1	Mean value of all individual results assessed throughout the measuring time Tm
				Only one of the listed results can be chosen. - Press ► . - Use ∇ to select the desired result. - Actuate ▲ or ▼ to switch the result to 1 (= on). - Complete the selection by pressing **RESULT** or return to the configuration catalogue by actuating Δ .
Hysteresis of tolerance monitoring and classification	**Hystere.**	0.00 ... 99.99 (µm)		Adjusting the hysteresis for symmetrically extending the class limits. The standard setting for this parameter is 1 µm.
Number of classes	**Classes**	0 ... 32		Adjusting the number of classes. The range between the upper and lower tolerance limit is divided into n classes of equal width. On entering "0", no classification will be carried out. The classification results can be printed out by activating the function "Prntstat".
Measuring range	**MR.± 2000** **MR. ± 200**			The instrument features two measuring ranges, namely measuring range ± 2,000 µm (resolution 0.1 µm) measuring range ± 200 µm (resolution 0.01 µm)

Transducer combination	**C: +A +B**			Select the transducer with ► and adjust the sign with ▼ . On entering "0", the transducer in question is not taken into consideration.
Adjusting the sensitivity	**Factor A** **Factor B**			Each probe value is multiplied with an individual factor. Thus, sensitivity deviations can be corrected. On entering "0.0", the probe in question is not taken into consideration.
Measuring value integration time	**Ti [ms]**	1.6 3.2 6.4 12.8 25.6 51.2 102.4 204.8 409.6 (milliseconds)		Every 1.6 milliseconds, a measuring value will be acquired. From these values, the instrument calculates a mean value which is related to a certain interval of time, namely the measuring value integration time Ti. The standard setting for this parameter is 102.4 milliseconds. A reduction of the integration time is reasonable if very fast updating of the measuring value acquisition is the point. Prolonged integration times stabilize the measuring value indication in case of vibrations influencing the measuring set-up, for example.
Selecting the results	**Sel. res**			Selecting the results which are to be indicated by actuating the key **RESULT**.
		Combine	0/1	Measuring result acc. to transducer combination
		MAX	0/1	Maximum value of a dynamic measurement
		MIN	0/1	Minimum value of a dynamic measurement
		(MX+M)/2	0/1	Mean of the maximum and minimum value of a dynamic measurement
		MAX-MIN	0/1	Difference between the maximum and minimum value of a dynamic measurement
		MEAN	0/1	Mean value of all individual results assessed throughout the measuring time Tm
				Statistical results
		n	0/1	Number of measurements or results
		xn	0/1	Ultimate measuring result
		x	0/1	x-bar, arithmetic mean of all meas. results
		s	0/1	Standard deviation
		Xmax	0/1	Maximum value
		Xmin	0/1	Minimum value
		R	0/1	Range, i.e. difference between the largest and the smallest result of all measurements
		Cp*	0/1	Theoretical process capability
		Cpk*	0/1	Actual process capability
				Cp* and Cpk* are calculated neglecting the normal distribution. Any number of parameters can be selected.
Indicating the combination	**DispCOMB**			The combination (e.g. +A+B) can be indicated with or without the master value. This function only affects the numerical indication. The dial-type indicators, the printout of the measuring value and the output via the computer interface are not influenced by this function.
		0		Indication of the combination without master value
		1		Indication of the combination with master value

Configuration parameter	Menu (Indication)	Settings /Indication		Explanations Parameter settings 1 = on; 0 = off
Indicating the statistics	**DispSTAT**			The statistical values can be output as follows:
		0		Only measuring result
		1		Measuring result - master value
		2		Measuring result + nominal value
		3		Measuring result - master value + nominal value
				A change will affect all output media (numerical and printer interface). As long as the function "Fading out the master value" is active, no values have to be accepted into the statistics.
Selecting the mode of indication	**Sel. ins**	1		The numerical display and the dial-type indicator indicate the same value (default setting).
		2		The dial-type indicator always shows the current measuring value, while the numerical display shows the result selected with **RESULT**.
Resolution of the numerical display	**Resol.**			Reducing the number of digits after the comma for indications on the numerical display.
		0.		No digit after the comma.
		0.0		One digit after the comma.
		0.00		Two digits after the comma (only possible with a measuring range of ± 200 µm).
Unit	**Unit**	µm inch		The selected setting is indicated by the µm or µinch indicator.
Language	**English**	English		Texts are given in English.
		Deutsch		Texts are given in German.
		FRANCAIS		Texts are given in French.
Brightness of the display	**Bright. 4**	Bright. 4		Brightness 100 %
		Bright. 3		Brightness 75 %
		Bright. 2		Brightness 50 %
		Bright. 1		Brightness 30 %
Calibrating the analogue instrument	**Cal. inst**	I–>0<–I	±0	Use key ► for subsequently calling up zero point, the
		I 0–>I	+10	right- and the left-hand end-scale deflection.
		I<–0 I	-10	If the pointer deflection does not agree with the scale, the pointer position can be corrected (calibrated) electronically with the keys ▲ and ▼.
				This calibration setting is to be stored with "Save" (see below).
Statistics	**Stat. off**	Stat. off		The statistics is switched off.
		Stat. on		The statistics is switched on. The statistics can be run for up to 25,000 individual values.
Selecting the statistical results	**Sel. stat**			Selection of the result for which to run the statistics:
		Combine	0/1	Measuring result acc. to transducer combination
		MAX	0/1	Maximum value of a dynamic measurement
		MIN	0/1	Minimum value of a dynamic measurement
		(MX+M)/2	0/1	Mean of the maximum and minimum value of a dynamic measurement

		MAX-MIN	0/1	Difference between the maximum and minimum value of a dynamic measurement
		MEAN	0/1	Mean value of all individual results acquired during the measuring time Tm
Number of results to be evaluated statistically	**n max**			Restricting the number of measurements to be evaluated statistically. As soon as the value input for "n max" is reached, it is no longer possible to take measurements. Input range: 0 ... 25,000. (0 = no restriction)
Statistical printout	**PrntStat**			Start the printing out of the statistics by actuating the ► key. After printing out, the instrument is in its basic condition.
Deleting the last statistical result	**Clr xn**			The last statistical result can be deleted. - Press key ►.
		n-1?		- Answer the safety inquiry with ▼. The last value will be deleted from the statistics and the instrument will return to its basic condition.
Deleting the statistics completely	**Clr stat**			The statistics can be deleted completely. - Actuate key ►.
		n = 0?		- Answer the safety inquiry with ▼. The statistics will be deleted and the instrument will return to its basic condition.
Controlling the measuring time Tm	**STRT man**			The measuring run is started with **START** and ended whenever wanted by actuating **START** again.
	STRT Tm			The measurement is started by pressing the key **START** and ends automatically after the preset measuring time Tm.
	STRT Tp			Measurement starts when actuating the key **START** and ends after a preset measuring time Tm. After a pause time Tp, the next measurement is started automatically. This cycle will be repeated until the key **START** is pressed again or the number of measurements "n" equals the value entered for "n max". Tm and Tp can be adjusted to values in a range between 0.01 and 999.99 seconds.
Input/output parameters for the serial interface (X10)	**I/O para**	computer	0/1	switches the computer interface on/off.
		Baud 9600		Data transfer rate (Baud rate)
		4800		
		2400		
		1200		
		600		
		300		
		150		
		75		
		Rec. XON		Record type X ON/X OFF
		Rec.--		No record

Configuration parameter	Menu (Indication)	Settings /Indication		Explanations Parameter settings 1 = on; 0 = off
				Data format/parity check:
		Char 8n1		8 data bits, no parity check, 1 stop bit.
		Char 7n2		7 data bits, no parity check, 2 stop bits.
		Char 7o1		7 data bits, odd parity check, 1 stop bit.
		Char 7e1		7 data bits, even parity check, 1 stop bit.
Printer parameters (X9 interface)	**Prnt Para**	Printer	0/1	Switches the printer interface on/off.
		Sel.prnt		Selection of the res. to be printed out from the below list:
		Num.	0/1	Result number
		Combine	0/1	Measuring result acc. to transducer combination
		MAX	0/1	Maximum value of a dynamic measurement
		MIN	0/1	Minimum value of a dynamic measurement
		(MX+M)/2	0/1	Mean value of the maximum and minimum value of a dynamic measurement
		MAX-MIN	0/1	Difference between the maximum and minimum value of a dynamic measurement
		MEAN	0/1	Mean of all individual values assessed during the measuring time Tm
		n	0/1	Number of measurements or results
		xn	0	Last measuring result (always switched off)
		x	0/1	x-bar, arithmetic mean of all meas. results
		s	0/1	Standard deviation
		Xmax	0/1	Maximum value
		Xmin	0/1	Minimum value
		R	0/1	Range = Xmax - Xmin
		Cp*	0/1	Theoretical process capability
		Cpk*	0/1	Actual process capability *Cp* and Cpk* are calculated neglecting the normal distribution. It is possible to select as many results as desired. (The width of the paper to be used for printing, however, has to be taken into account).
		Cust. Tx.		Customer-specific text. By means of a terminal or a computer, it is possible to enter a text via the RS 232 C interface, which then serves as record head. The default text of the standard configuration, however, will be overwritten: - Connect the terminal or the computer to the serial interface X9 of the VMF 2000. - Set the Printer parameters (Prnt para) to "Cust.Tx"
		Input! 0 ... 56 Charac.		- Press key ►. - The entered text is transferred from the computer to the VMF 2000. In the numerical display, each character of the text is counted. - Press key ►, as soon as the text was transferred completely. - Use the parameter setting "Save" to permanently store the customer-specific text. The above procedure can be aborted with **RESULT**.
		Format 0/1		Formatted output on the printer 0 = unformatted measuring record, without record head and form feed 1 = measuring record with record head and form feed (FormFeed)

		Baud 9600 4800 2400 1200 600 300 150 75	Data transfer rate (Baud rate)
		Rec.XON Rec. --	Record type X ON/OFF No record
		Char 8n1 Char 7n2 Char 7o1 Char 7e1	Data format/parity check: 8 data bits, no parity check, 1 stop bit. 7 data bits, no parity check, 2 stop bits. 7 data bits, odd parity check, 1 stop bit. 7 data bits, even parity check, 1 stop bit.
Gauge block table	**G.block**		For adjusting the transducer sensitivity (see "Sensit"), the heights of two gauge blocks are required. This table may comprise up to 10 gauge block heights. On pressing ►, the value for gauge block 1 is displayed. Use ∇ to select one of the 10 gauge block heights. Press ►, ▲ and ▼ to modify the numerical value. Use △ to return to the main catalogue.
Transducer Correction	**ProbCorr**		Corrects (linearises) the curve of transducer A and transducer B respectively.
		A-3036.4	View/edit correction table of transducer A. The number at the right of the “A” is the uncorrected (raw) value of the transducer. On the right large display the correction value is displayed. The correction value is edited by means of ►, ▲ and ▼
		B-3033.1	Correction value table for transducer B
		AutoCorr	► starts the automatic correction. The correction is done separately for each transducer in + and – direction.
		Corr A+	► step by step linearization of the positive direction of transducer A
		Corr A- Corr B+ Corr B-	
		Clear	Clears the linearization tables. For each transducer the + and – direction is cleared separately
		Clear A+	Key ► clears the positive direction of the linearization table for transducer A. The prompt “Clr ?” has to be confirmed by ▼, otherwise the function is aborted without clearing the table.
		Clear A-	same for the negative direction
		Clear B+ Clear B-	
		Print	► prints the correction tables via the RS232 “Printer”

Configuration parameter	Menu (Indication)	Settings /Indication	Explanations Parameter settings 1 = on; 0 = off
Sensitivity	**Sensit.**		The transducer sensitivity is corrected by comparing with two known values and changing the factors "Factor A" and/or "Factor B". Press key ►.
		G.block 1 xxx.x	Use ▲ and ▼ to select the first gauge block. After having placed this gauge block into the measuring device, the first measurement can be started with ►.
		G.block 2 xxx.x	With ▲ and ▼ , a different gauge block can be chosen. Start the second measurement with ►.
		OK!	By means of this confirmation, the instrument returns to its basic condition. Erroneous inputs are signaled by the message "Stop". The instrument also returns to its basic condition and the procedure must be repeated completely. **NOTE** In case one of the probe combinations +A, -A, +B, or -B was selected, only the sensitivity of the transducer in question will be corrected. For sum or differential measurements, the sensitivities of both transducers are influenced. Correct results can only be obtained, if the two transducers are deflected to the same extent.
Transducer symmetry	**Symmetry**		The sensitivity of transducer A will be adjusted to that of transducer B. Here, "Factor A" will be changed as required, while "Factor B" remains unchanged. Press key ► . Deflect the transducer over the range to be balanced. First, the VMF 2000 recognizes the range limits by the reversion of the transducer ' direction of movement. During the transducer ' deflection, measured values are assessed over this range and a correction factor is calculated for transducer A. This process is repeated until two successive correction values differ by less than 0.0001. Only then will "Factor A" be changed.
		OK!	The symmetry function is ended successfully. The instrument returns to its basic condition.
Max. correction value	**max. corr.**		Maximum allowed value by which the zero point (offset) is allowed to be changed by the measuring/reference function. On entering "0", the correction value is not transferred to the measuring instrument, but output via the analogue output 3 of the reference instrument.
Setting speed of the zero setting value	**corr v**		Speed [µm/s] with which the zero setting value is changed to the corrected value during the measuring/reference function. Adjustable range: 0.2 ... 60 µm/s.

Sensitivity adjustment of the analogue outputs	**Fac.-DA 1** **Fac.-DA 2** **Fac.-DA 3**			Adjustable range 0 ... 150 mV/µm (analogue output 2 set to "DAC2-rel" : 0 ... 150 V/full scale deflection of the dial-type indicator).
Zero point setting of the analogue outputs	**Adj.-DAC** DAC1->0<- DAC2->0<- DAC3->0<-			Use ► to select the output. Set the zero point with ▲ and ▼.
Selecting the value to be output via the analogue outputs	**Comb.DAC**			Press ►. Set the value to be output via the analogue output 1 with ▲ and ▼.
	DAC1	C		Combination result (A+B or A-B)
	DAC1	A		Transducer A
	DAC1	B		Transducer B
	DAC1	off		0 V (switched off)
	DAC2	C		Press ▽ and adjust the value to be output via the analogue output 2 as well.
	DAC3	C		Press ▽ and adjust the value to be output via the analogue output 3 as well.
		...		Press ▽.
	DAC2-rel			Use ▲ and ▼ to adjust the analogue output 2 to an output which is dependent on the indication range (0 ... 150 V/full-scale deflection of the dial-type indicator)
	DAC2-fix			or to an output which is independent of the indication range (0 ... 150 mV/µm).
Parameters of the interference blanking				
Max. allowed signal increase speed	**Slope**			0 ... 999 µm/ms
Holding time	**Sl-Hold**			0 ... 999.9 ms Minimum duration for blanking out disturbances.
Error indication delay time	**Sl-Error**			0 ... 999.9 ms. If the holding time exceeds the error indication delay time, the "IB-ERROR" signal is activated.
Parameters of the probe checking				
Min. path	**s (k)**			0 ... 99.9 µm
Time stretch	**Tk [s]**			0 ... 9.999 seconds
Selecting the value to be output via the BCD output	**Nom. val.** **Act. val.**			Use ▲ and ▼ to select between master and actual value output.
Indication range setting for the dial-type indicator	**MR. *1**			The inputs "R1in" to "R7in" set the indication ranges ± 1, ± 3, ± 10, ± 30, ± 100, ± 300, ± 1,000 µm or
	MR.*10			± 10, ± 30, ± 100, ± 300, ± 1,000, ± 3,000, ± 10,000 µm.
Input/output test	**IO-Test**			Press ►.
		X7-P02 O	0	The signal of socket X7, pin 02 is being tested. Here, a signal is output, the current signal state being "0". With ►, the state of the output can be changed. Use ▲/▼ to indicate the state of the following or preceding input or output.

Configuration lock	**Lock off**	Code	Any code number between 0000 and 9999 can be entered.
		Block?↓	Safety inquiry
		→0←?↓	In case key ▼ is pressed, the configuration setting is blocked and "Block zero setting?" is displayed. If the zero setting key (master) is also to be blocked, press ▼ again. Actuating the keys ∇ or △ blocks only the instrument configuration.
		Lock on	It is no longer possible to change parameters and settings. In order to guarantee configuration locking even after switching on again, it must be stored permanently by means of function "Save".
		Lock off	The configuration locking is cancelled by entering a new code number.
Printing instrument configuration	**PrntConf**		All settings of the VMF 2000 can be printed with **PrntConf** (via the printer interface X10). If the printer interface is deactivated, it is activated for the duration of the printing, afterwards it is deactivated again. Start printing with ►.

Configuration parameter	Menu (Indication)	Settings /Indication	Explanations Parameter settings 1 = on; 0 = off
Standard configuration	**S. config**		On delivery, the permanently stored standard configuration is active. This configuration can be recalled at any time, although measuring and configuration parameters could have been changed and stored permanently. In order to remain active even after switching on again, the standard configuration has to be stored by means of the function "Save". Only on doing so, will be overwritten the customer-specific configuration. If, however, the standard configuration is called up without being saved again, the customer-specific configuration is again valid after switching on. Loading the standard configuration: Press key ▶.
		Yes: (↓)	If the now appearing safety inquiry is answered with ▼, all currently valid settings will be overwritten. If these settings were not stored permanently, they are deleted irrevocably. The instrument returns to the basic condition.
		Stop !	If the safety inquiry is to be answered in the negative, either **RESULT** (leaving the configuration level) or one of the keys ∇ or Δ (staying in the configuration level) must be actuated.
Saving the settings	**Save**	Save	Actuate the key ▶.
		Yes:(↓)	If the safety inquiry is answered by pressing key ▼, all current measuring and instrument configuration settings will be stored permanently.
		OK!	All settings valid before will be overwritten, i.e. deleted. "OK!" will be displayed on the text indication. If the safety inquiry is to be left unanswered, either actuate the key **RESULT** to leave the configuration level or press one of the keys ∇ or Δ to call up different configuration parameters.

6.10 Function keys

Frequently used functions or settings can be assigned to one of the function keys, thus making them directly accessible.

The following functions can be assigned to the keys **F1** and **F2**:

- configuration parameter settings,
- measuring condition settings,
- indication of a certain measuring result, i.e. indication of the probe combination or a statistical result, for example.

Function key assignments can be stored as well by means of the function "Save".

Assigning a function to F1 or F2:

For assigning any function to one of the function keys, the function in question must be called up first. If, for example, the result MAX - MIN is to be assigned to **F1**, select MAX - MIN and have it indicated by pressing the key **RESULT**. Press **Konfig.** (on the rear of the instrument) and keep it depressed. Press **F1**. "Prg. F1" appears on the text indication for a short time. Now, this result is directly accessible by pressing the **F1** key.

Deleting a function key assignment:

The assignment of a function key is deleted by keeping the key **Konfig.** on the rear of the VMF 2000 depressed and actuating the keys ⌂ and **F1** or **F2**.

This setting can be stored durably with "Save".

6.11 Serial interfaces

The VMF 2000 features two serial RS 232 C interfaces.

Interface X10 exclusively outputs measuring values and results on a printer. The interface is adapted to the connected printer via the instrument setting "Prntpara".

Interface X9 serves for communicating with a host computer. Measuring values and instrument parameters can be inquired and programmed by means of the computer. The interface is adapted to the connected host computer via the instrument setting "I/O para".

In case an interface is not connected or not used, the interface in question is to be switched off in the instrument settings.

Adjustable parameters:

Data transfer rate (Baud rate):
75; 150; 300; 600; 1,200; 2,400; 4,800; 9,600 bits/second

Interface record:

Rec.-	no record
Rec.XON	software handshake using the control characters XON = dec. 17 and XOFF = dec. 19

Data format:

Char	8n1	8 data bits, no parity check,	1 stop bit
Char	7n2	7 data bits, no parity check,	2 stop bits
Char	7o1	7 data bits, odd parity check,	1 stop bit
Char	7e1	7 data bits, even parity check,	1 stop bit

The pin assignment of the sockets is illustrated in section 6.11.

Host computer interface

Via the host computer interface, measuring values and results can be inquired, measuring conditions and configuration parameters inquired and programmed and functions activated.

Nomenclature

In the text passages of this section, commands will be marked by quotation marks ("...") which are not part of the actual command. Those parts of the commands given in parenthesis are optional,
e.g. P10 (,xxx.x (,yyy.y)) <Tcr>.

Brackets, however, signal ASCII control characters,

e.g. <CR> means "carriage return" = hexadecimal value "D" = dec. 13.

Command structure:

- A command sent by the host computer to the VMF 2000 usually consists of an ASCII character string which must always be completed with the control character <CR>. Any other control character is ignored by the VMF 2000.

- The response of the VMF 2000 is completed with the control characters <CR> and/or <LF>. After switching on the instrument, this end mark (designated <Tcr> here) is adjusted to the control character <CR>. It can be changed by means of the parameter "P30,...".

- An inquiry command starts with a letter followed by a parameter number.

  Example: Inquiring measuring values (here: 896.3 µm)
  Host computer: M1<CR> VMF 2000: M1,896.3 <Tcr>

- An adjustment command starts with a letter followed by a parameter number and the value of the parameter. The parameter number and the value are separated by a comma.

  Example: Adjusting the measuring range to ± 2,000 µm
  Host computer: P1,2000<CR> VMF 2000: P1,2000<Tcr>

- Several functions are activated by a single letter.
  Example: Adjusting the indication to 0 or to the master value
  Host computer: Z<CR> VMF 2000: Z<Tcr>

- Parameters and measuring values are always transferred as metric values (µm), even if the instrument is adjusted to inch.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the **left-hand** side, while on the **right-hand** side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Activating the interface software

The command "I<CR>" activates the interface software and causes it to output an identification text, which among other data contains the version number of the software.

Example:
I<CR> I,VOLLMER GMBH,VMF2000,3.46<Tcr>

The interface software only has to be activated if it has been previously deactivated with "X<CR>".

Deactivating the interface software

After having deactivated the interface software with the command "X<CR>", the VMF 2000 ignores any information sent by the host computer. The only exception to the above statement is the command "I<CR>".

Example:
X<CR> X<Tcr>

Control commands

Synchronous/asynchronous mode of operation:
After having activated the VMF 2000 by means of the command "I<CR>", it is automatically switched to the synchronous mode of operation, i.e. the VMF 2000 does only send data if the host computer explicitly requests information.
In addition, it is possible to adjust the asynchronous mode of operation, during which the instrument sends data on own initiative, e.g. the measuring value after the measuring time Tm or changes in the instrument settings (P34,...).

A<CR>	A<Tcr>	Sets the asynchronous mode of operation (= switches off the synchronous mode).
S<CR>	S<Tcr>	Sets the synchronous mode of operation (= switches off the asynchronous mode).

Starting/ending the measuring time:
Starting and ending the measuring time can be accomplished in three ways. (For adjusting the measuring time, see "P10".)

F1<CR>	F1<Tcr>	Starts a measuring time, the end of which is known (equivalent to the setting "STRT Tm").
F2<CR>	F2<Tcr>	Starts a measuring time of unknown end (equivalent to "STRT man" or "STRT Tp").
F3<CR>	F3<Tcr>	Ends the measuring time in case of setting "STRT man" and cancels the measuring or pause time when setting "STRT Tp" is active.

Functions

R<CR>	R<Tcr>	Resets the VMF 2000. The instrument returns to the basic state which was active after switching on.
Z<CR>	Z<Tcr>	Sets the indication to zero or to the entered master value, respectively.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the left-hand side, while on the right-hand side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Outputting a value on the numerical display

T1,xxxx<CR>	T1,xxxx<Tcr>	Indicates the value on the numerical display (only numerical values with sign and decimal point). xxxx = decimal number with decimal point max. 6.5 digits (1999999)
T1,<CR>	T1, <Tcr>	Restore previous indication.
Example: T1,123.45<CR>	T1,123.45<Tcr>	The value 123.45 is indicated on the numerical display.

Outputting a text on the text indication field

T2,xxxx<CR>	T2,xxxx<Tcr>	Indicates a text on the text indication field. xxxx = max. 8 characters (ASCII text) The entered text is shown left justified on the text indication field.
T2,<CR>	T2,<Tcr>	Restores the previous indication.
Example: T2,Hallo<CR>	T2,Hallo<Tcr>	The text "Hallo" appears on the text indication field.

Inquiring measuring values and results

In the measuring range ± 200 µm two digits follow the decimal point, in the measuring range ± 2,000 µm one digit.

M<CR>	Mn,xxx.x<Tcr>	default result type selected with "P32,..."; here, n is the number of the chosen measuring value
M1<CR>	M1,xxx.x<Tcr>	result of the transducer combination
M2<CR>	M2,xxx.x<Tcr>	mean value over the measuring time Tm
M3<CR>	M3,xxx.x<Tcr>	minimum value during the measuring time Tm (MIN)
M4<CR>	M4,xxx.x<Tcr>	maximum value during the measuring time Tm (MAX)
M11<CR>	M11,xxx.x<Tcr>	MAX-MIN
M12<CR>	M12,xxx.x<Tcr>	(MAX-MIN)/2
M80<CR>	M80,n <Tcr>	n = number of values accepted into the statistics
M82<CR>	M82,xxx.x<Tcr>	statistical mean value
M83<CR>	M83,xxx.x<Tcr>	statistical minimum value (Xmin)
M84<CR>	M84,xxx.x<Tcr>	statistical maximum value (Xmax)
M85<CR>	M85,xxx.x<Tcr>	theoretical process capability Cp*
M86<CR>	M86,xxx.x<Tcr>	standard deviation
M87<CR>	M87,xxx.x<Tcr>	actual process capability Cpk*
M88<CR>	M88,xxx.x<Tcr>	range
M89<CR>	M89,xxx.x<Tcr>	ultimate measuring result xn
M98<CR>	Maaaa,bbbb<Tcr>	individual values of transducer A and B. The measuring values are coded hexadecimally and have to be multiplied: in measuring range ± 200 µm by 0.01/256 µm; in measuring range ± 2,000 µm by 0.1/256 µm.
M99<CR>	Maaaaaa,bbbbbb<Tcr>	individual values of transducer A and B. The measuring values are coded hexadecimally and have to be multiplied: in measuring range ± 200 µm by 0.01/256 µm; in measuring range ± 2,000 µm by 0.1/256 µm. When the indicated value exceeds ± 3,276.7 µm in the measuring range of ± 2,000 µm or ± 327.67 µm in the measuring range of ± 200 µm, the numbers "aaaa" and "bbbb" are extended to 6 hexa-decimal digits for "M98" and to 8 for "M99".

Inquiring and adjusting parameters

Measuring range:		
P1<CR>	P1,xxx.x<Tcr>	Inquires the measuring range setting. Measuring range = xxx.x µm
Example:		
P1,2000<CR>	P1,2000<Tcr>	Adjusts the measuring range to ± 2,000 µm. Note: Function "Z" (set to zero) will be cancelled. Thus, a master measurement has to be performed afterwards.
Example:		
P1,1.85E+2<CR>	P1,200<Tcr>	Adjusts the measuring range to ± 200 µm. The VMF 2000 selects the next larger measuring range.
Conversion factor, unit:		
P3<CR>	P3,xxx.x,tt<Tcr>	Inquires conversion factor and unit.
Example:		
P3<CR>	P3,1.0E-3,mm<Tcr>	Outputs the obtained measuring values in millimetres after conversion with factor 0.001.
Indication format:		
P5<CR>	P5,6.5,x<Tcr>	Inquires the resolution of the numerical display. 6.5 number of digits (not adjustable) x number of digits following the decimal point For the ± 200 µm measuring range 0 ... 2 digits can be set, for the ± 2,000 µm measuring range 0 ... 1.
P5,<CR>	P5,6.5,x<Tcr>	Adjusts the maximum resolution.
Combination indication		
P6<CR>	P6,x<Tcr>	Inquires the setting of the combination indication. x = 0 combination without master value x = 1 combination - master value
Example:		
P6,1<CR>	P6,1<Tcr>	Sets the indication of the combination value to "combination with master value".
Zero setting value		
P7<CR>	P7,x<Tcr>	Inquires the status of the zero setting value. x = 0 deactivates the zero setting value x = 1 activates the zero setting value
Example:		
P7,0<CR>	P7,0<Tcr>	Deactivates the zero setting value.
Master value:		
P8<CR>	P8,xxx.x<Tcr>	Inquires the master value.
P8,xxx.x<CR>	P8,xxx.x<Tcr>	Adjusts the master value.
Example:		
P8,530<CR>	P8,530<Tcr>	Sets the master value to 530 µm.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the **left-hand** side, while on the **right-hand** side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Measuring and pause time, start mode:		
P10<CR>	P10,(xxx.x(,yyy.y))<Tcr>	Inquires measuring and pause time. xxx.x = Tm, yyy.y = Tp In case no argument is provided, the measuring time Tm is started and stopped manually.
P10,<CR>	P10,<Tcr>	Sets the measuring time to be started and stopped manually (equivalent to setting "STRT man").
P10,15<CR>	P10,15<Tcr>	Adjusts a measuring time Tm of 15 seconds (equivalent to setting "STRT Tm").
P10,8,1.5<CR>	P10,8,1.5<Tcr>	Sets the measuring time Tm to 8 seconds and the pause time Tp to 1.5 seconds (equivalent to setting "STRT Tp").
Delay time:		
P11<CR>	P11,0.1<Tcr>	Inquires the delay time, which in this case was set to 0.1 seconds.
P11,1.2<CR>	P11,1.2<Tcr>	Adjusts a delay time of 1.2 seconds.
Tolerance limits:		
P21<CR>	P21,xxx.x,yyy.y<Tcr>	Inquires the tolerance limits. The smaller of the two values is always taken to be the lower tolerance limit. External measurement: xxx.x= lower tol. limit yyy.y= upper tol. limit Internal measurement: xxx.x= upper tol. limit yyy.y= lower tol. limit
P21,xxx.x,yyy.y <CR>	P21,xxx.x,yyy.y<Tcr>	Adjusts the limits for tolerance monitoring (see above).
P21,<CR>	P21,<Tcr>	switches off tolerance monitoring.
Example:		
P21,1E3,-500<CR>	P21,1000,- 500<Tcr>	Adjusts tolerance monitoring for internal measurements, the lower tolerance limit to -500.0 µm and the upper one to 1,000.0 µm.
Classification, number of classes:		
P26<CR>	P26,xx<Tcr>	Inquires the set number of classes. xx = number of classes
P26,xx<CR>	P26,xx<Tcr>	Adjusts the number of classes "xx" and divides the range between the upper and lower tolerance limit into xx classes of equal width.
P26,0<CR>	P26,0<Tcr>	Switches off the classification.
End mark <Tcr>:		
P30<CR>	P30,xxx(,yyy)<Tcr>	Inquires the character sequence of end mark <Tcr>.
P30,xxx (,yyy)<CR>	P30,xxx(,yyy)<Tcr>	Sets the character sequence of the end mark to <Tcr>. In place of the control character <CR>, the control character sequence "xxx,yyy" is sent. "xxx" and "yyy" are the decimal equivalents of the control characters.
Example:		
P30,10,13<CR>	P30,10,13<LF><CR>	Sets the end mark sequence <Tcr> to the ASCII control characters <LF> = dec. 10 and <CR> = dec. 13.
Default measuring value type:		
P32<CR>	P32,n<Tcr>	Asks for the default measuring value type which is to be output in the asynchronous mode or in case of measuring value inquiries accomplished with "M<CR>".
P32,n<CR>	P32,n<Tcr>	Sets the default measuring value type. n = 1: result of the transducer combination n = 2: mean value over the meas. time Tm n = 3: MIN value over the meas. time Tm n = 4: MAX value over the meas. time Tm ... Continue as described in "Inquiring measuring values and results" (see above).

Changed parameter settings:

P34<CR>	P34,n<Tcr>	Inquires if parameters were changed by manual settings. n = : number of the changed parameter n = 0 : no parameter was changed (In the asynchronous mode, any parameter change is reported immediately.)
Example:		
P34<CR>	P34,83<Tcr>	Means that the range of indication was changed.
A<CR>	A<Tcr>	Switches on the asynchronous mode.
	P34,19<Tcr>	Means that the master value was accepted.

Transducer combination:

P50<CR>	P50,n,m<Tcr>	Inquires the transducer combination. n = 1 +A n = -1 -A m = 2 +B m = -2 -B
P50,-1,2<CR>	P50,-1,2<Tcr>	Sets the transducer combination to "-A+B".
P50,1<CR>	P50,1<Tcr>	Sets the transducer combination to "+A". Note: In contrast to function "P51", the correction factors are not influenced.

Transducer combination, correction factors:

P51<CR>	P51,(tttt)<Tcr>	Inquires transducer combination and correction factors in the form of an equation. The transducer combination is presented by the symbols X1 or X2 (for transducer A or B, respectively) and is multiplied by the related correction factors.
P51,tttt<CR>	P51,tttt<Tcr>	Adjusts transducer combination and correction factors. Note: Function "Z" (accepting the master value) will be cancelled, i.e. a master measurement must be taken thereafter!
Example:		
P51,0.5*X1<CR>	P51,+.5*X1<Tcr>	Sets the transducer combination to "+A" and the correction factor (Factor A) to 0.5.
Example:		
P51,X1-X2<CR>	P51,+1*X1-1*X2<Tcr>	Sets the transducer combination to "+A-B" and the correction factors (Factor A and Factor B) to 1.0.

Correction factors:

P52,n<CR>	P52,n,xxx.x<Tcr>	Inquires the correction factor for transducer A (n = 1) or for transducer B (n = 2).
Example:		
P52,2<CR>	P52,2,1.992<Tcr>	The correction factor for transducer B is 1.992.
P52,1,3,2,2.5<Tcr>	P52, 1,3,2,1.5<Tcr>	Sets factor A to 3.000 and factor B to 1.500.

Balancing the symmetry:

P53<CR>	P53<Tcr>	Activates the function "Symmetry". After successfully completing the balancing process, the VMF 2000 acknowledges with "P53<Tcr>". The balancing process can be aborted with "Q" or via the keyboard.
	E53<Tcr>	Error during the balancing process or abortion.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the **left-hand** side, while on the **right-hand** side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Meas./ref function

P54<CR>	P54,x<Tcr>	Inquires the status of the meas./ref function. x = 0 function has not yet been executed x = 1 function is active x = 2 function has been terminated successfully x = 3 running error
P54,1<CR>	P54,1<Tcr>	Starts the meas./ref function.
P54,0<CR>	P54,0<Tcr>	Stops the measuring time of the meas./ref function.

Example:

P54,1<CR>	P54,1<Tcr>	Starts the meas./ref function.
P54,0<CR>	P54,0<Tcr>	Stops the measuring time.
P54<CR>	P54,1<Tcr>	Function is still active.
P54<CR>	P54,2<Tcr>	Function has been terminated successfully.

Error signal interferences blanking

P55<CR>	P55,x<Tcr>	Inquires the status of the error signal (X8/41). x = 0 no error x = 1 error signal is active (X8/41 output set)
P55,0<CR>	P55,0<Tcr>	Resets the error signal (X8/41 output).

Example:

P55<CR>	P55,0<Tcr>	Error signal not set.

Path (s(k)) for probe checking

P56<CR>	P56,xx.x<Tcr>	Inquires the setting of s(k).
P56,xx.x<CR>	P56,xx.x<Tcr>	Sets s(k) to xx.x µm.
P56,<CR>	P56,0<Tcr>	Sets s(k) to the standard value.

Example:

P56,10<CR>	P56,10<Tcr>	Sets s(k) to 10 µm.

Time (Tk[s]) for transducer checking

P57<CR>	P57,x.xxx<Tcr>	Inquires the setting of Tk.
P57,xx.x<CR>	P57,xx.x<Tcr>	Sets Tk to x.xxx seconds.
P57,<CR>	P57,.001<Tcr>	Sets Tk to the standard value.

Example:

P57,.01<CR>	P57,.01<Tcr>	Sets Tk to 10 ms.

Status of transducer checking

P58<CR>	P58,x<Tcr>	Inquires the status of the error signal (X5/19 output). x = 0 no error x = 1 error signal is active (AX5/19 output set)
P58,0<CR>	P58,0<Tcr>	Resets the error signal (X5/19 output).

Example:

P58<CR>	P58,0<Tcr>	Error signal is not set.

Balancing the symmetry:

P59<CR>	P59,x<Tcr>	Inquires the status of the symmetry function. x = 0 function has not yet been executed x = 1 function is still active x = 2 function has been terminated successfully x = 3 running error or abortion
P59,1<CR>	P59,1<Tcr>	Starts the balancing function.

P59,0<CR>	P59,0<Tcr>	Aborts the symmetry function.

Example:

P59,1<CR>	P59,1<Tcr>	Starts the symmetry function.
P59<CR>	P59,1<Tcr>	Function is still active.
P59<CR>	P59,2<Tcr>	Function has been terminated successfully.

Selecting the results to be indicated:

P60<CR> P60,x,y,....,z<Tcr> Inquires the results to be indicated with RESULT.

- x = 1 result of the transducer combination
- x = 2 mean value over the meas. time Tm (MEAN)
- x = 3 minimum value over the meas. time Tm (MIN)
- x = 4 maximum value over the meas. time Tm (MAX)
- x = 11 MAX-MIN
- x = 12 (MAX+MIN)/2

Statistical results

- x = 80 number of measurements (n)
- x = 82 statistical mean value
- x = 83 statistical minimum value (Xmin)
- x = 84 statistical maximum value (Xmax)
- x = 85 theoretical process capability Cp*
- x = 86 standard deviation s
- x = 87 actual process capability Cpk*
- x = 88 range (Xmax - Xmin)
- x = 89 last statistical result

P60,1,11,88<CR> P60,1,11,88<Tcr> With the key **RESULT**, it can be selected between indicating the combination, MAX-MIN or R.

Selecting the results to be printed out:

P61<CR> P61,x<Tcr> Asks for the result to be printed out after the end of the measuring time or after activating "Prnt Stat"(x: see "P60,...").

Complement to the selection of the results to be printed out

P61<CR> P61,x1,x2,...xn<Tcr> Inquires the selection of the results which are to be printed with PrntStat or after the measuring time has run out.

- x = 0 numbers of selected results
- x = 1 result of the probe combination
- x = 2 mean value over the measuring time (MEAN)
- x = 3 minimum value over the measuring time (MIN)
- x = 4 maximum value over the measuring time (MAX)
- x = 11 MAX–MIN
- x = 12 (MAX+MIN)/2

Statistical results

- x = 80 number of measurements (n)
- x = 82 statistical mean value
- x = 83 statistical minimum value (Xmin)
- x = 84 statistical maximum value (Xmax)
- x = 85 theoretical process capability Cp*
- x = 86 standard deviation (s)
- x = 87 actual process capability Cpk*
- x = 88 Range (range = Xmax–Xmin)

P61,<CR> P61,0,1,2,80,82,83,84,85,86,87,88
Adjusts the standard selection.

Example:

P61,0,1,2<CR>	P61,0,1,2<Tcr>	The measuring record includes the result number, the combination and the mean value. The statistics printout is deactivated.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the **left-hand** side, while on the **right-hand** side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Customer-specific text:

P62<CR>	P62,xxx,yyy,...,zzz<Tcr>	Inquires the customer-specific text. The ASCII characters are output as decimal numbers such that also control characters for formatting can be inserted into the text. The maximum number of characters to be entered is 56.
P62,<CR>	P62,<Tcr>	Deletes the customer-specific text.

Example:
P62,86,79,76,76,77,69,82,32,71,109,98,72,13,10<CR>
P62,86,79,76,76,77,69,82,32,71,109,98,72,13,10<Tcr>
Enters "VOLLMER GMBH"<CR><LF> as customer-specific text.

Formatted printout

P65<CR>	P65,x<Tcr>	Inquires the settings of the measuring record. x = 0 unformatted measuring record, without record head and form feed x = 1 measuring record with record head and form feed
P65,<CR>	P65,1<Tcr>	Activates the standard setting.

Example:

P65,0<CR>	P65,0<Tcr>	Sets the measuring record to "unformatted".

Analogue output sensitivity:

P70<CR>	P70,x,y,x,y,x,y,<Tcr>	Inquires the sensitivity settings of the analogue outputs. x = number of the analogue output (1 ... 3) y = sensitivity (in mV/µm or V/full scale deflection, in case output 2 is dependent on the indication range of the dial-type indicator).
P70,1,20,2,10,3,40<CR>	P70,1,20,2,10,3,40<Tcr>	Sets analogue output 1 to 20 mV/µm, analogue output 2 to 10 V/full scale deflection, analogue output 3 to 40 mV/µm.

Shifting the zero point of analogue outputs (Offset correction):

P71<CR>	P71,x,y,x,y,x,y,<Tcr>	Inquires the setting of the zero offset. x = number of the analogue output (1 ... 3) y = zero offset (has to be multiplied by 4.88 mV).

Example:
Analogue output 3 features a zero point error of 74 mV.

Zero offset: y = -74 mV/4.88 mV = -15.16

This value has to be added to the already adjusted zero offset:

P71,3<CR>	P71,3,-9<Tcr>	The adjusted zero offset is -9 * 4.88 mV. The new value to be set is: -9-15 = -24.
P71,3,-24<CR>	P71,3,-24<Tcr>	

Maximum inclination:

P72<CR>	P72,xxx.x<Tcr>	Inquires the setting of the maximum inclination for blanking out disturbances (in µm/ms).
P72,40<CR>	P72,40<Tcr>	Sets the max. inclination to 40 µm/ms.

Holding time:

P73<CR>	P73,.xxx<Tcr>	Inquires the adjusted holding time for blanking out disturbances (in seconds).
P73,.08<CR>	P733,.08<Tcr>	Sets the holding time to 80 ms.
P73,0<CR>	P73,0<Tcr>	Holding time = 0 (blanking switched off)

Error indication delay time:

P74<CR>	P74,.xxx<Tcr>	Inquires the set error indication delay time for blanking out disturbances (in seconds).
P74,.25<CR>	P74,.25<Tcr>	Adjusts the error indication delay time to 250 ms.

Selecting master value/measured value:

P75<CR>	P75,x<Tcr>	Inquires the value to be output via the BCD outputs. x = 0 master value output x = 1 measured value output
P75,1<CR>	P75,1<Tcr>	The measured value is output via the BCD outputs.

Selecting the analogue indication range *1/*10:

P76<CR>	P76,x<Tcr>	Inquires the set analogue indication range. x = 0 MR*1 (1 µm - 1,000 µm) x = 1 MR*10 (10 µm - 10,000 µm)
P76,1<CR>	P76,1<Tcr>	Sets the analogue indication range to MR*10.

D/A-converter combination:

P77<CR>	P77,x,y,x,y,x,y<Tcr>	Inquires the values to be output via the analogue outputs. x = number of the analogue output (1 ... 3) y = identification of the value to be output 0 = no output via this output (always set to 0 V) 1 = value of transducer B 2 = value of transducer A 3 = transducer combination
P77,1,3,2,2,3,1<CR>	P77,1,3,2,2,3,1<Tcr>	Adjusts the value to be output via analogue output 1 to transducer combination, analogue output 2 to the value of transducer A, analogue output 3 to the value of transducer B.
P77,3,0<CR>	P77,3,0<Tcr>	Switches off analogue output 3.

Making analogue output 2 dependent on/ independent of the indication range:

P78<CR>	P78,x<Tcr>	Inquires the setting of analogue output 2. x = 0 dependent on the indication range x = 1 independent of the indication range
P78,1<CR>	P78,1<Tcr>	Makes the analogue output 2 independent of the indication range. The unit of the factor is mV/µm.

Calibration value

P79<CR>	P79,xxx.x<Tcr>	Requests the calibration value
P79,123.4	P79,123.4<Tcr>	sets the calibration value to 123.4 µm

Selecting the results for tolerance monitoring and classification:

P80<CR>	P80,n<Tcr>	Requests the selected results.
P80,n<CR>	P80,n<Tcr>	Adjusts the result to be output. n = 1: result of the transducer combination n = 2: mean value over the meas. time Tm n = 3: MIN value over the meas. time Tm n = 4: MAX value over the meas. time Tm n = 11: MAX-MIN value over the meas. time Tm n = 12: (MAX + MIN)/2 value over the meas. time Tm
Example:		
P80,2<CR>	P80,2<Tcr>	Means that the mean value over the measuring time Tm will be output.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the **left-hand** side, while on the **right-hand** side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Selecting the results to be evaluated statistically:

P81<CR>	P81,n<Tcr>	Inquires the result(s) to be evaluated statistically.
P81,n<CR>	P81,n<Tcr>	Adjusts the result(s) to be evaluated statistically. n = 1: result of the transducer combination n = 2: mean value over the meas. time Tm n = 3: MIN value over the meas. time Tm n = 4: MAX value over the meas. time Tm n = 11: MAX - MIN value over the meas. time Tm n = 12: (MAX+MIN)/2 value over the meas. time Tm
Example:		
P81,2<CR>	P81,2<Tcr>	Means that the mean value is to be evaluated statistically.

Printing, deleting, switching on and off the statistics:

P82<CR>	P82,s<Tcr>	Inquires the status of the statistics.
P82,s<CR>	P82,s<Tcr>	s = 0: statistics switched off s = 1: statistics switched on s = 2: delete last x (equivalent to "Clr xn") s = 3: delete statistics completely (equivalent to "Clr stat") s = 4 print statistical results

Indication range of the dial-type indicator:

P83<CR>	P83,n,m<Tcr>	Inquires the adjusted indication range and the selected indication.
P83,n,m<CR>	P83,n,m<Tcr>	Adjusts indication range and indication. n = 1: ± 1 µm n = 2: ± 3 µm n = 3: ± 10 µm ... n = 9: ± 10,000 µm n = 0: Rel. Tol. m = 1: the numerical display and the dial-type indicator indicate the same results. m = 2: the dial-type indicator indicates the current measuring result, irrespective of the indication on the numerical display.
Example:		
P83,4,2<CR>	P83,4,2<Tcr>	Sets the indication range to ± 30 µm. The dial-type indicator indicates the measuring value according to the set combination, while the numerical display provides the result adjusted with the **RESULT** key.

Maximum number of measurements:

P84<CR>	P84,x<Tcr>	Inquires "n max".
P84,x<CR>	P84,x<Tcr>	Sets "n max" to x.
Example:		
P84,50<CR>	P84,50<Tcr>	Sets "n max" to 50.

Language:

P85<CR>	P85,x<Tcr>	Inquires the adjusted language. x = 1: German x = 2: English x = 3: French
Example:		
P85,3<CR>	P85,3<Tcr>	Sets the language to French.

NOTE: In the provided examples, the command sequence sent by the host computer, which is completed with <CR>, is, as a rule, given on the **left-hand** side, while on the **right-hand** side the command sequence of the VMF 2000, which ends with <Tcr>, is provided.

Unit:

P86<CR>	P86,x<Tcr>	Inquires the set system of units. x = 1 : metric x = 2 : imperial
Example:		
P86,2<CR>	P86,2<Tcr>	Adjusts the imperial system of units.

Brightness:

P87<CR>	P87,x<Tcr>	Inquires the adjusted brightness of the display. x = 1 ... 4 x = 4: brightness 100 %
P87,1<CR>	P87,1<Tcr>	Adjusts the brightness of the display to 30 %.

Indicating the statistics

P88<CR>	P88,x<Tcr>	Inquires the setting of the statistical indication x = 0: indicating only measuring result x = 1: indicating meas. result – master value x = 2: indicating measuring result + nominal value x = 3: indicating meas. result – master value + nominal value
Example:		
P88,1<CR>	P88,1<Tcr>	The statistical values are indicated with master value.

Hysteresis for tolerance monitoring and classification:

P90<CR>	P90,xx.xx<Tcr>	Inquires the hysteresis value.
P90,xx.xx<CR>	P90,xx.xx<Tcr>	Sets the hysteresis value.
Example:		
P90,10.55<CR>	P90,10.55<Tcr>	Adjusts a hysteresis value of 10.55 µm.

Nominal value:

P91<CR>	P91,xxx<Tcr>	Inquires the nominal value.
Example:		
P91,2E3<CR>	P91,2000<Tcr>	Sets the nominal value to 2.0 mm (2,000 µm).

Measuring value integration time Ti:

P92<CR>	P92,.xxx<Tcr>	Inquires the meas. value integration time Ti in seconds.
P92,.xxx<CR>	P92,.xxx<Tcr>	Sets the meas. value integration time Ti in seconds.
Example:		
P92,1.6E-3<CR>	P92,.0016<Tcr>	Sets the measuring value integration time Ti to 1.6 ms. Note: Function "Z" (accepting the master value) will be cancelled, i.e. a master measurement must be taken thereafter !

Gauge block:

P93,x<CR>	P93,x,yyy.y<Tcr>	Inquires the adjustment of gauge block no. x. x = 1 ... 10, number of the gauge block yyy.y: adjusted height
P93,1<CR>	P93,1,1000.0<Tcr>	Inquires the adjustment of gauge block no. 1(here, 1,000 µm).
P93,5,1500,6,1600<CR>	P93,5,1500,6,1600<Tcr>	Adjusts gauge block no. 5 to 1,500 µm and gauge block no. 6 to 1,600 µm.

Maximum correction offset (measuring/reference function):

P95<CR>	P95,xxx.x<Tcr>	Inquires the maximum correction offset.
P95,100<CR>	P95,100<Tcr>	Sets the maximum correction offset to 100 µm.
P95,0<CR>	P95,0<Tcr>	Switches on the special measuring/reference function. (Mean value is output via the analogue output 3.)

Activating dc voltage/carrier frequency:
By means of this function, the carrier frequency system can be switched off such that it is possible to measure dc voltages for test purposes.

P97<CR>	P97,x<Tcr>	Inquires the adjusted mode of operation. x = 0 dc voltage x = 1 carrier frequency
P97,0<CR>	P97,0<Tcr>	Sets the operation mode to dc voltage.

I/O-test:

P98,x,y<CR>	P98,x,y,z<Tcr>	Inquires the status of an input or output. x = socket number (5 ... 8) y = pin number z = logic level (0 = low, 1 = high)
P98,8,45<CR>	P98,8,45,0<Tcr>	Inquires the status of pin 45 of socket X8.
P98,5,16,1<CR>	P98,5,16,1<Tcr>	Sets the output pin 16 of socket X5 to 1 (high).
P98,0<CR>	P98,0<CR>	Switches off the I/O test. During the I/O test, the operability of the VMF 2000 is restricted. Therefore, it is indispensable to complete the I/O test with this command.

Lock:

P99<CR>	P99,n<Tcr>	Inquires the status of the keyboard lock. n = 0 not locked n = 1 all settings locked n = 2 keys locked n = 3 configuration and zero setting locked
Example:		
P99,0<CR>	P99,0<Tcr>	Switches off the lock. All instrument settings can be changed.
P99,2<CR>	P99,2<Tcr>	Locks the keys. Now, the instrument can only be controlled via the computer interface or the control inputs.

Save:

P100<CR>	P100<Tcr>	Permanently stores all settings in an EEPROM. The acknowledgement message is sent after storing the settings.

Error messages:

E1<Tcr>	Command unknown.
E2<Tcr>	Parameter not existent/adjustable.
E3<Tcr>	Parameter value exceeds admissible limits.
E4<Tcr>	Numerical format or syntax faulty.
E5<Tcr>	Error during data transfer (faulty record type, parity, baud rate, etc.).
E6<Tcr>	Received text too long.
E7,M...<Tcr>	Measuring value at probe connections exceeds admissible range.
E8<Tcr>	For the time being, the command cannot be executed (since e.g. the function was not activated in the system configuration).
E9<Tcr>	For the time being, the parameter cannot be adjusted.

Examples:

P51,X1<CR>	P51,+1*X1<Tcr>	Set the transducer combination to "+A".
M1<CR>	E7,M1,-2850.0<Tcr>	The measuring value at transducer connection A exceeds the measuring range.

6.12 Functional diagram, pin assignment of the sockets

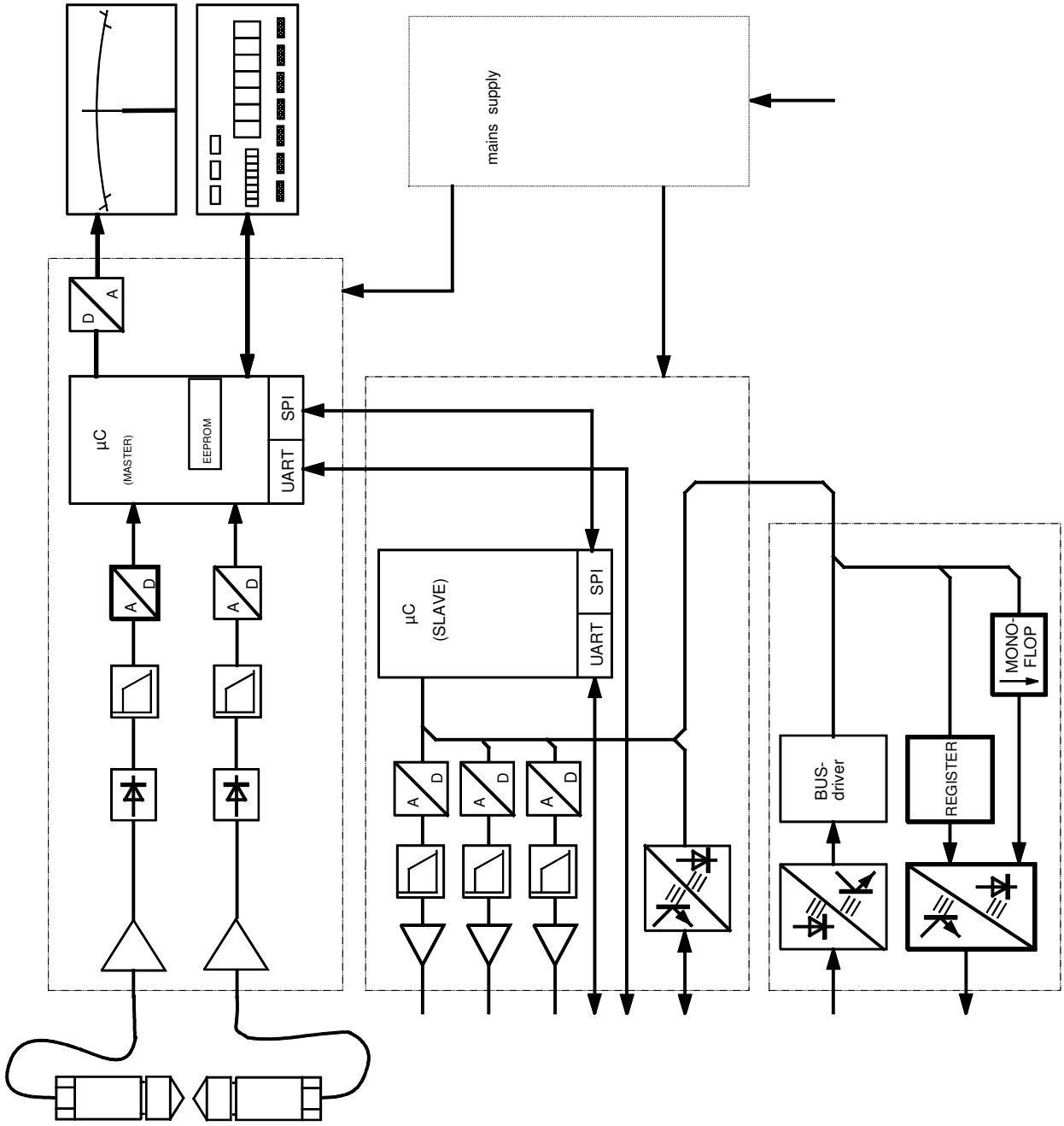


Fig. 14 Block diagram of the VMF 2000

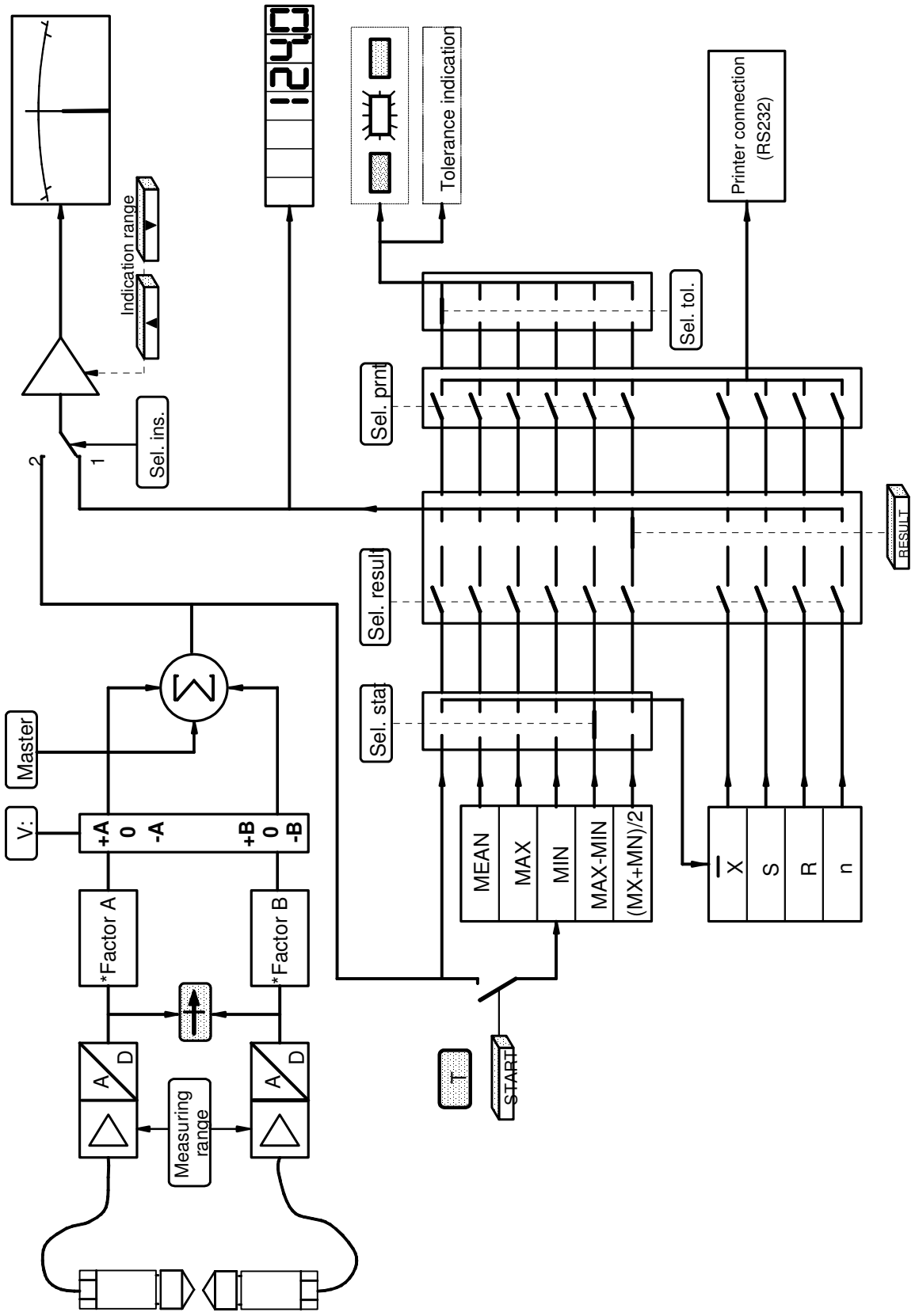


Fig. 15 Functional diagram of the VMF 2000

X2, X3 : 6-pol. Tuchel, female

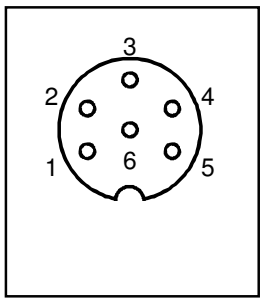


Fig. 16
Pin assignment of the interfaces X2 and X3
*(*transducer *sockets A and B)*

1 Oscillator voltage
2 Voltage input 1 mV/µm
3 Current input 1 µA/µm
4 Earthing contact (ground)
5 Oscillator voltage
6 Voltage input 0.3 mV/µm

On the rear side of the instrument, there is a selector switch for compensating for the cable length (see figure 2). Adjust this switch according to the used cable length by means of an appropriate screwdriver.

Cable length	Switch position	Cable capacitance comp.
0 m	0	0 nF
15 m	1	2,2 nF
25 m	2	3,8 nF
35 m	3	5,3 nF
45 m	4	6,9 nF

The compensation setting is valid for both probe inputs. Therefore, identical cable lengths are presumed.

The characteristic curve of an inductive probe is changed by the capacitance of the connecting cable. The VMF 2000 features a circuit which largely compensates for this influence.

The compensation takes place between pin 6 (signal input) and pin 4 (ground) of the transducer sockets X2 and X3.

X4 : 3-pol. Tuchel, female

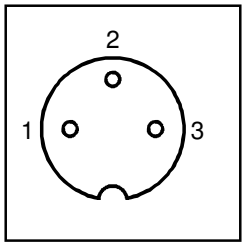
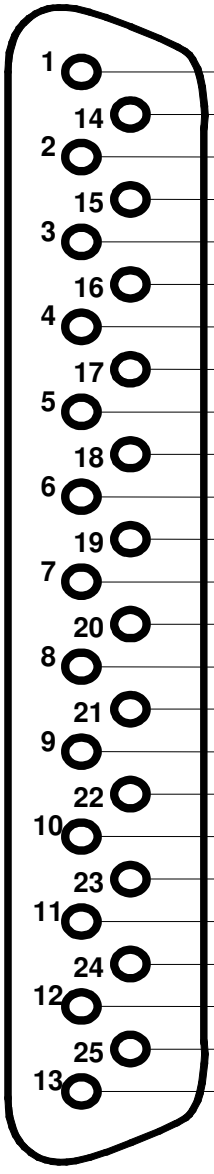


Fig. 17
Pin assignment of the interface X4

1 *Analogue output 1 (equivalent to X5/24)*
2 Earthing contact
3 Analogue output 2 (equivalent to X5/25)

X5: Sub-D 25 pol. female socket



1	0 Volt internal supply voltage
2	15...24 V internal supply voltage
3	Cathode: inputs pin 3, 4, 5, 6
4	Anode: outputs pin 16, 17, 18, 19
5	Input not yet assigned
6	Synchronization error
7	Input not yet assigned 2 (do not use !)
8	Synchronization successful
9	Accept calibration value
10	Symmetry error
11	Transducer checking
12	Transducer checking:
13	N.C.
14	N.C.
15	N.C.
16	N.C.
17	N.C.
18	N.C.
19	GND
20	DAC 3: 0...150 mV/µm
21	GND
22	DAC 2: 0...150 V/indication range
23	GND
24	DAC 1: 0...150 mV/µm
25	N.C.

Fig. 18
Pin assignment of the interface X5

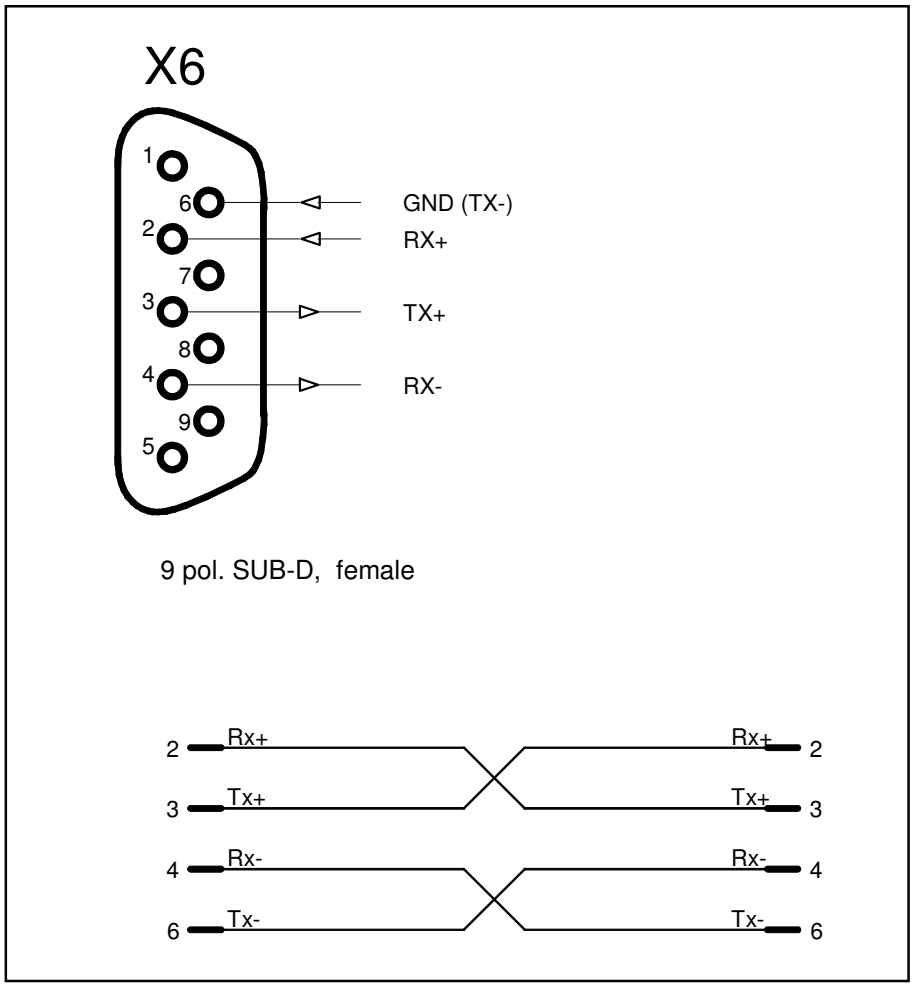
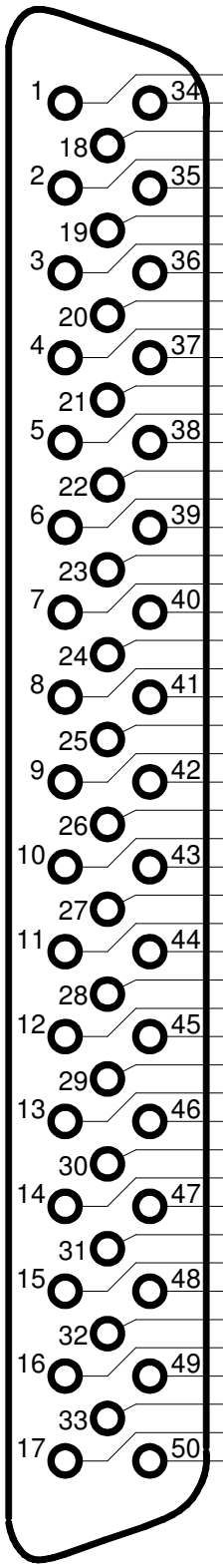


Fig. 19
Pin assignment of the interface X6 (measuring/reference) and the cable connecting two VMF 2000

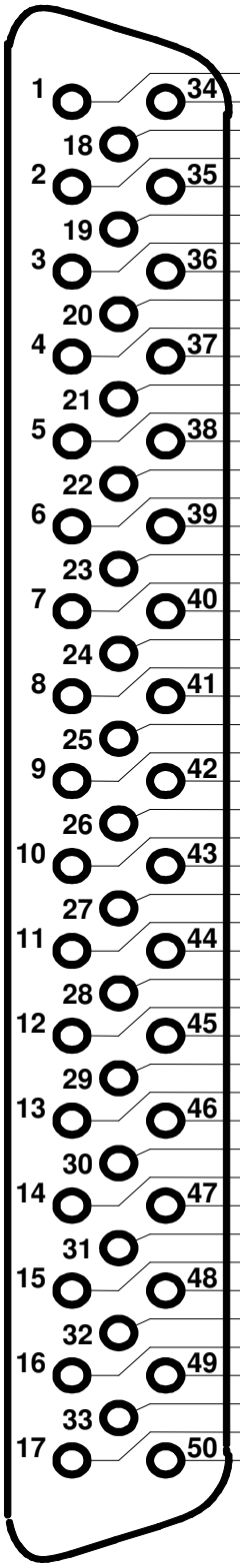
X7: 50 pol. Sub-D female



1	BCD-output:	A1out
2	BCD-output:	A2out
3	**15...24V internal voltage supply**	
4	BCD-output:	B1out
5	BCD-output:	B2out
6	BCD-output:	**Collector A1out...D1out, A2out...D2o**
7	BCD-output:	C1out
8	BCD-output:	C2out
9	BCD-output:	**Collector A1out...D1out, A2out...D2o**
10	BCD-output:	D1out
11	BCD-output:	D2out
N.C. 12		
13	BCD-output:	A3out
14	BCD-output:	A4out
15	BCD-output:	**Collector A3out...D3out, A4out...D4o**
16	BCD-output:	B3out
17	BCD-output:	B4out
18	BCD-output:	**Collector A3out...D3out, A4out...D4o**
19	BCD-output:	C3out
20	BCD-output:	C4out
N.C. 21		
22	BCD-output:	D3out
23	BCD-output:	D4out
N.C. 24		
25	BCD-output:	A5out
26	BCD-output:	C5out
27	BCD-output:	**Collector A5out...D5out**
28	BCD-output:	B5out
29	BCD-output:	D5out
30	BCD-output:	**Collector sign**
31	S1 Strobe for BCD-input (LSD)	
32	BCD-output:	sign
33	**Collector for Strobes S1...S3**	
34	S2 Strobe for BCD input	
35	S3 Strobe for BCD-input (LSD)	
N.C. 36		
37	BCD-input:	A1in
38	BCD-input:	A2in
39	**Cathode BCD-input**	
40	BCD-input:	B1in
41	BCD-input:	B2in
42	**Cathode accept master value**	
43	BCD-input:	C1in
44	BCD-input:	C2in
45	**Cathode BCD-Hold**	
46	BCD-input:	D1in
47	BCD-input:	D2in
48	**0 Volt internal voltage supply**	
49	BCD-Hold	
50	Accept master value	

Fig. 20
Pin assignment of the interface X7
Note: From fall 2004 the following pins are shorted internally: 19…28 and 30…32

X8: 50 pol. Sub-D female



1	R1out, indication range 1 µm (10 µm)
2	R2out, indication range 3 µm (30 µm)
3	15...24V internal voltage supply
4	R3out, indication range 10 µm (100 µm)
5	R4out, indication range 30 µm (300 µm)
6	Collector: Indication range output
7	R5out, indication range 100 µm (1,000 µm)
8	R6out, indication range 300 µm (3,000 µm)
9	Collector: Reject, rework
10	R7out, indication range 1000 µm(10,000 µm)
11	Rework
12	Collector: Balancing the symmetry complete
13	Balancing the symmetry complete
14	Reject
15	Collector: Master value equals presetting
16	Master value equals presetting
17	Interference blanked out
18	Collector: Transducer A or B overloaded
19	Transducer A or B overloaded
20	System works
21	Collector: "Within 0 V"
22	Confirm zero setting
23	IB-Error, error signal interference blanking
24	Collector: interference blanked out
25	Cancel error signal
26	Accept value into statistics
27	Collector: IB-error and system works
28	Synchronization (Start meas./ref. function)
29	Print / Cancel statistics
30	Cath.: Balanc., Synchron.,Value. i. stat., Can. Err.
31	Balancing the symmetry
32	Fade out zero setting value
33	Cathode: Accept master value setting
34	Accept master value
35	Zero setting
36	Cathode: Zero setting
37	Fade out master value
38	Accept upper tolerance limit
39	Cathode: Accept up./low. tolerance limit
40	R1in, indication range 1 µm (10 µm)
41	Accept lower tolerance limit
42	Cathode: Fade out master value setting
43	R3in, indication range 10 µm (100 µm)
44	R2in, indication range 3 µm (30 µm)
45	Cathode: indication range input
46	R5in, indication range 100 µm (1,000 µm)
47	R4in, indication range 30 µm (300 µm)
48	0 Volt internal voltage supply
49	R7in, indication range 1,000 µm (10,000 µm)
50	R6in, indication range 300 µm (3,000 µm)

Fig. 21
Pin assignment of the interface X8
Note: From fall 2004 the following pins are shorted internally 19…26 and 27…32

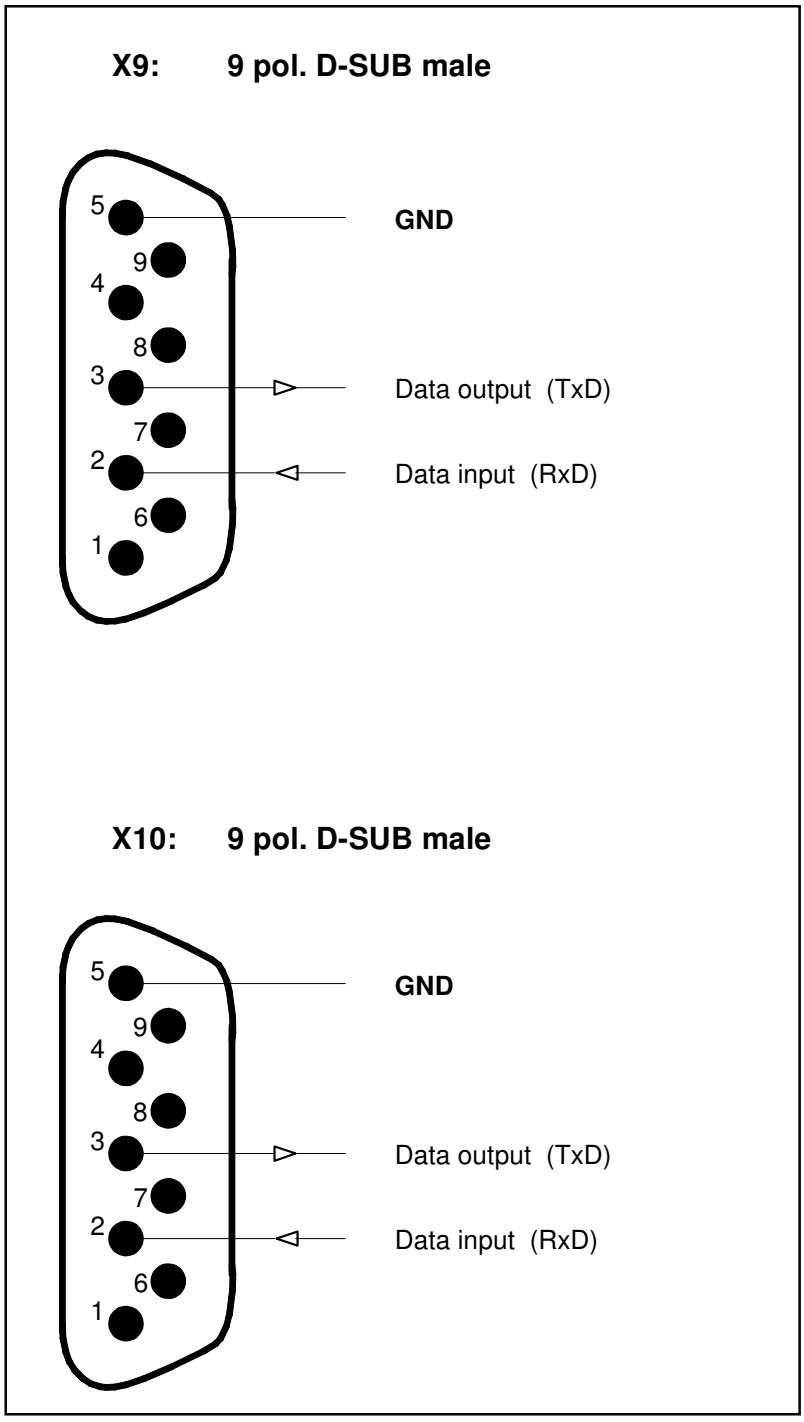


Fig. 22
Pin assignments of the interfaces X9 (host computer) and X10 (printer)

6.13 Notes on maintenance

Cleaning:

The housing may be cleaned with a wetted piece of cloth. Acetone and acetone compounds are **never** to be used.

Exchanging fuses:

- Switch off the instrument.
- Pull the mains cable from the socket outlet X1 on the rear of the instrument.
- Open the cover of the voltage selector by means of a screwdriver.
- Pull out the two fuse carriers.
- Replace defective fuses by fuses of **the same** type:

  630 mA, time-lag

Opening the instrument:

For reasons of security, all modifications to and interventions in the instrument may only be carried out by trained personnel on the express written approval of the manufacturer.

6.14 Exchanging the software

The software of the VMF 2000 is stored in 2 EPROMs. Updates must be carried out by trained personnel by exchanging both EPROMs. Besides the relevant safety provisions, the following instructions must be complied with in particular:

- Before opening the unit, disconnect it from the power supply by pulling the plug from the mains socket outlet.

- EPROMs and other components in the instrument may be destroyed or damaged by electrostatic charges. It is also possible that the instrument is damaged only partially such that defects manifest themselves only after a couple of weeks or months. Therefore, when opening or repairing the unit, always use conductive pads and grounding straps for your wrist!

After exchanging the software, the standard configuration has to be loaded (with "S.config"), the instrument settings changed as required and stored with "Save".

6.15 Error list

No.	Error message	Cause	Remedy
1	"Printer" / "Computer"	The data transmission to the printer or the computer is too slow. Baud rate too small, printer/computer program is too slow.	Set a higher Baud rate on the VMF 2000 as well as on the printer/computer. Use a faster printer. Set the printer "on line". Accept less values/time ("Accept value into statistics" input).
2	SLV-Fehl	The connection to the slave processor can not be established.	
		No supply voltage at the printed circuit board of the slave processor.	Check the voltage supply at the printer circuit board of the slave processor; if necessary, replace it.
		Slave-processor, EPROM, RAM... defective.	Check slave processor, EPROM, RAM...; if necessary, replace them.
		Connection cable master-slave defective.	Check the connection cable master-slave; if necessary, replace it.
		False software version of the printed circuit board of the slave processor.	Replace EPROM.
3	Rev.-Fehl		The EPROM has been replaced. The standard configuration has to be loaded with "s.config" and saved with "save". Afterwards, the desired standard configuration can be adjusted and – if necessary – saved with "save" (see section 4.8)
4	IRam Fehl	RAM of the processor is defective.	Send it in to have it repaired.
5	Prom Fehl	EPROM is defective.	Replace EPROM.
6	ERam Fehl	External RAM defective.	Replace the RAM-chip.
7	EEP-Fehl	EEPROM is defective.	Send it in to have it repaired.

7 Technical Data

VMF 2000		**Order no. 5312410**
Dimensions (length x width x height)		216 x 177 x 198 mm
Mass		4.6 kg
Supply voltage		240 V ± 10 % 220 V ± 10 % 120 V ± 10 % 100 V ± 10 %
Frequency range		50...60 Hz
Power consumption		20 W
Fuse		630 mA (time-lag)
Adjustable measuring ranges		± 2,000 µm ± 200 µm
Excitation voltage		5 V
Carrier frequency		20 kHz
Settling time (Ti = 1.6 ms)		
of the dial-type indicator		300 ms
of the numerical display		400 ms
of the analogue outputs		10 ms
	to 70 % of final value	7,5 ms
	to 99 % of final value	10 ms
of the digital outputs	RS 232	20 ms
	tolerances	5 ms
	BCD	200 ms
Holding time of the numerical display		200 ms
Deviation spread (related to the measuring range)		
of the dial-type indicator		1.5 %
of the numerical display		0.01 %
of the analogue outputs		0.05 %
of the digital outputs	(RS 232)	0.01 %
Hysteresis of the dial-type indicator (related to the measuring range)		1.5 %
Max. number of connectable probes without exceeding the deviation spreads		2
Working temperature range		+ 10 ... + 40 °C
Operating temperature range		0 ... + 40 °C
Storing temperature range		- 10 ... + 40 °C
Analogue outputs		
Voltage range		± 10 V
Sensitivity		0 ... 150 mV/µm 0 ... 150 V/indication range (only output 2)
Admissible load resistor		> 2 kOhm
Residual voltage ripple (related to the measuring range)		< 10 mV
Reference voltage		0 V
Cutoff frequency (Ti = 1,6ms, 3 dB)		50 Hz
Digital inputs		
Limit values	I_e	< 50 mA
	$V_{e\ High}$	> 4.5 V (I_e = (V_e - 1,2 V) / 1 kOhm)
	$V_{e\ Low}$	< 2.5 V (I_e = V_e / 1.5 kOhm)
Digital outputs		
Limit values	V_{ce}	< 35 V
	I_c	< 50 mA
High	V_{ce}	< 5 V at 30 mA

Indication ranges of the dial-type indicator	± 1, ± 3, ± 10, ± 30, ± 100, ± 300, ± 1,000, ± 3,000, ± 10,000 µm
Scale divisions	0.02; 0.1; 0.2; 1; 2; 10; 20; 100; 200 µm
Measuring value classification	max. 30 classes
Configuration memory	EEPROM
Writing cycles (Save)	> 10,000
Interfaces:	
2 serial interfaces	RS 232 C
Meas./ref. interface	
..Digital I/Os	31 control inputs 44 control outputs

Revision:

Aug. 2nd 2007 sem	X8 – Pin 27 and Pin 29 description was wrong
Oct. 30th 2008 sem	Settling time of analog outputs has been corrected